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ISSCSH
INTERNATIONAL SOCIETY FOR SYSTEMS AND COMPLEXITY SCIENCES FOR HEALTH

Programme Overview

TIME	FRIDAY		SATURDAY	
8:00 AM	**Networking**		**Reflections on Day 1**	
8:15 AM	**Welcome and Opening Remarks**		**TED 5**	
8:30 AM	**TED 1**		MODERATOR: David Aron	
8:45 AM	MODERATOR: R. Chad Swanson			
9:00 AM				
9:15 AM			**Key Note**	
9:30 AM	**Panel Presentations**		MODERATOR: Paige McDonald	
9:45 AM	MODERATOR: Paige McDonald		**Key Note**	
10:00 AM			MODERATOR: Curt Lindberg	
10:15 AM	Break		Break	
10:30 AM	**Discussion**		**TED 6**	
10:45 AM			MODERATOR: Gaetano R. Lotrecchiano	
11:00 AM	**TED 2**			
11:15 AM	MODERATOR: Randy Thompson			
11:30 AM			**Hot Topics Explorations – Open Space**	
11:45 AM			MODERATOR: David Aron	
12:00 PM	Lunch			
12:15 PM	Lunch		Lunch	
12:30 PM	Lunch		Lunch	
12:45 PM	Lunch		Lunch	
1:00 PM	**Grad Student Presentations**		Lunch	
1:15 PM	MODERATOR: Gaetano R. Lotrecchiano		**Direction Setting for the International Society for Systems and Complexity Sciences for Health**	
1:30 PM			MODERATORS: Joachim Sturmberg,	
1:45 PM			Gaetano R. Lotrecchiano	
2:00 PM			Paige McDonald, Curt Lindberg	
2:15 PM	**Putting Complexity Into Practice & Policy - Fishbowl Conversation**			
2:30 PM	MODERATOR: Curt Lindberg		**TED 7 - Health System Stream**	**TED 8 - Education & Improvement Steam**
2:45 PM			MODERATOR: Peter Tsasis	MODERATOR: Chad Swanson
3:00 PM				
3:15 PM	Break			
3:30 PM	**TED 3 - Physiology Stream**	**TED 4 - Patient Care Stream**	**Closing Reflections**	
3:45 PM			MODERATOR: Joachim Sturmberg	
4:00 PM	MODERATOR: Joachim Sturmberg	MODERATOR: Peter Tsasis		
4:15 PM				
4:30 PM				
4:45 PM				
5:00 PM				
5:15 PM				
5:30 PM	**Launch of Society**			
5:45 PM				
6:00 PM				
6:15 PM				
6:30 PM				

Mini-TED Talks 1
MODERATOR: R. Chad Swanson

Friday, October 27, 2017

Sturmberg	If you change the way you look at things, things you look at change. Clinical Disease - Cause or Consequence?
Potts	Complexity Of Being A Millennial
McDonald, Lindberg and Hausmann	Is the Learning Health System a Complex Adaptive System or a Complex Responsive Process?
Lindberg	Positive Deviance: A Novel Process for Optimizing Antibiotic Use
Winkler	A Puzzling Question: How Can Different Phenotypes Possibly Have Indistinguishable Disease Symptoms?
Palmer	Complexity Sciences Dramatically Improve Biomarker Research and Use

If you change the way you look at things, things you look at change. Clinical Disease - Cause or Consequence?

Joachim Sturmberg

University of Newcastle
Newcastle, Australia
jp.sturmberg@gmail.com

What is disease? Our thinking and our approaches to medical care overwhelmingly focus on the macroscopic representation of disease, and a focus on removing or restoring those abnormalities. This lens sees the disease as the cause of a patient's ailment. However, the macroscopic features of disease can only occur as the consequence of persistent physiological mal-function. This misunderstanding of cause and consequence of disease has important implications for clinical care.

Two examples: Is Alzheimer's disease caused by plagues and tangles – its anatomical characteristic, or are plagues and tangles the end-product of metabolic dysfunction and thus the reason for its associated cognitive decline? Is ischaemic heart disease caused by narrowing of coronary arteries – its anatomical characteristic, or is narrowing of the coronary arteries the end-product of inflammatory processes in blood vessels?

This presentation will highlight how things change when you look at a patient's complaint not through an anatomical but rather a physiological lens. Shifting the focus on appreciating the underlying physiological network processes behind the patient's complaint, be it classified simply as a sign/symptom, or a more complex syndrome or a specific disease, will fundamentally shift the ways to approach his management.

This presentation will set the scene for the physiology stream of this conference.

Complexity Of Being A Millennial

Jennifer Potts

Billings Clinic
Billings, MT, USA
jpotts1@billingsclinic.org

If you Google “Millennial’s are…” the autocomplete “lazy” comes up as one of the top three options. As part of the group of people born between 1980 and late 1990s I do not think of myself as lazy. I am a full time mom, a full time occupational therapist, and full time interested in contributing to the field of health care quality and complexity. Stereotypically I do find myself wanting instant gratification, frequent feedback, and trying to find a good life-work balance. Regardless of birthday: Who wouldn’t want those things?

Things that do not engage me include: siloed approaches to providing healthcare, mechanistic explanations and processes for clinical advances, and health care improvement initiatives that do not recognize leadership on every level. The chasm between research and clinical practice continues to be wide and yet we have this group of clinicians who are young in practice and want to be engaged in meaningful work.

How do we create opportunities and leadership structures that harness the millennial desire for meaning in work in a healthcare environment that has become legalistic and task-based? I will describe my personal journey from a chance invite to a complexity science network in 2012 to leading teams in emergent multidisciplinary work grounded in Relational Coordination, Positive Deviance, and Liberating structures. I will describe roles and structures that continue to help me improve my own clinical practice as well contribute to the complex healthcare processes of which I am a part.

This would be best presented in TED talk format and would speak to attendees who are looking toward graduation into this complex field, new practitioners potentially disillusioned with the large transition in complexity awareness between university and practice, and leaders looking to engage the next generation of front line trailblazers.

Is the Learning Health System a Complex Adaptive System or a Complex Responsive Process?

Paige L. McDonald, Curt Lindberg and Robert Hausmann

The George Washington University
Washington, DC, USA
paigem@gwu.edu

Background. Learning Health Systems (LHSs) have been conceptualized as the future of healthcare by the Institute of Medicine (IOM). Current conceptualizations emphasize a systems approach to health and the use of electronic health record data to inform continuous quality improvement. Current conceptualizations of LHSs give insufficient attention to the social interactions in these complex systems. Conceptualizing the LHS from a complexity lens unlocks our understanding of the social dynamics requisite in supporting continuous adaptation within a cyber-social-technical system (Friedman).

Aim & Objectives. In this presentation, we propose the value of conceptualizing LHSs from a complexity lens. We pose the question of whether a LHS is a complex adaptive social system or a complex responsive process (Stacey). We outline the distinctions between the two conceptualizations to explore which is more appropo to further understanding of the social dynamics within a cyber-social-technical system focused on continual adaptation and improvements in healthcare.

Results & Conclusions. We do not draw conclusions within this presentation. Rather, we hope to generate discussion which will inform the way forward in conceptualizing LHSs from a complexity lens.

Positive Deviance: A Novel Process for Optimizing Antibiotic Use

Curt Lindberg

Billings Clinic
Billings, MT, USA
clindberg@billingsclinic.org

Background. Over and inappropriate use of antibiotics in the chronic hemodialysis (CHD) population is a significant problem. While data is limited, studies suggest that 30% of antibiotic doses administered in dialysis facilities are not indicated. Such use patterns contribute to rising antibiotic resistance in CHD patients and spread of multidrug-resistant bacteria in hospitals and the community. Stemming these problems will require more effective antibiotic stewardship programs in dialysis facilities.

Methods. A multi-pronged intervention built around the novel social and behavioral change process Positive Deviance (PD) was implemented in six dialysis units. The Positive Deviance process is founded on the observation that there are individuals in organizations whose uncommon (deviant) practices generate better (positive) results than peers and involves uncovering and spreading these practices. The intervention was comprised of five components.

1. Engagement of dialysis unit leaders
2. Education of dialysis unit staff on evidence-based guidelines for optimizing antibiotic use
3. Implementation of PD process
4. Collection and review of patient antibiotic use information
5. Debrief of intervention experience

Results. Qualitative analysis of semi-structured interviews of unit clinical managers and the regional director of operations uncovered five key themes: 1) adoption of new practices in the antibiotic decision-making process; 2) establishment of new partnerships and communication patterns; 3) widespread, inclusive engagement; 4) multiple, reinforcing learning activities and; 5) accountability and communication fueled by antibiotic log.

Conclusion. This first known use of PD process to improve antibiotic stewardship in dialysis units was well-received by dialysis staff and stimulated improvements in antibiotic prescribing.

A Puzzling Question: How Can Different Phenotypes Possibly Have Indistinguishable Disease Symptoms?

Tilo Winkler

Massachusetts General Hospital, and Harvard Medical School
Boston, MA, USA
twinkler@mgh.harvard.edu

Homeostasis is a cardinal feature of our body's response to changes in the environment. However, there are circumstances under which seemingly small changes may have much greater impact through emergent phenomena affecting the development of life as well as disease. Revisiting Peter Macklem's paper “Emergent phenomena and the secrets of life” [1] inspired a review of our current understanding of key concepts of emergent behavior at the "edge of chaos" between liquids and crystals where the spontaneous development of self-organized order occurs that is essential for both the development of life and the control of homeostasis. These phenomena occur at all length scales from the molecular to the whole-body level. During asthma attacks for example, bronchoconstriction within the airway tree results in the emergence of self-organized clustering of severe airway constriction causing large ventilation defects while other areas of the lungs remain well ventilated. This transition from stable open airways (homeostasis) to the regional clustering of severe airway constriction occurs at a critical point in the interactions among airways. The critical point itself can be shifted by several factors including increase in airway wall thickness, which is linked to airway inflammation and remodeling in asthma. However, damage of the epithelial layer, which may be a primary cause of asthma symptoms, seems to be caused by severe airway constriction within ventilation defects. That means that different asthma phenotypes causing increased airway wall thickness would shift the critical point of airway stability and promote the emergence of ventilation defects leading to symptoms independent of the phenotype. In summary, the example shows how different underlying processes (phenotypes) may affect or trigger disease specific emergent phenomena that cause symptoms without phenotype specific characteristics.

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Complexity Sciences Dramatically Improve Biomarker Research and Use

James Palmer

Caldwell Palmer, Clinical Care Research & Improvement: Consulting, Design and Implementation
Denver, CO, USA
CaldwellPalmer@aol.com

This presentation argues that Complexity Sciences already dramatically improve medical biomarkers as a sea-change regarding: search strategies, actionable clinical uses; future research. This medical sector-wide impact is unevenly known and appreciated.

This presentation calls for increased networked efforts to expand understanding, clinical use and trans-theoretical biomarker research.

Evidence used cites biomarkers body wide: organs, systems, tissues, functions, structures, cells. Human pulse, e.g., beats per minute, is a vital sign, an ancient biomarker. However, heart rate variability dynamics (HRVD) - R-R interval patterns - are not as well-known and used. Complexity sciences for decades have shown HRVD as a useful biomarker. HRVD as biomarker, after RCT, saves many Neonates' lives from sepsis in NICUs.

Clinically significant, complexity sciences related biomarkers used or developing are cited: Early infection/sepsis detection in acute stroke care; brain structure, cell shape quantification and Alzheimer's; Saccadic eye movements in Gaucher's disease; Clotting structures and timing; Cancer cell shapes; retinal vasculature; HRVD and psycho-physio illness.

Complexity Sciences describe pattern dynamics biomarkers which provide earlier diagnosis and accurate prognosis. Dynamic biomarkers are appropriate to body dynamics and dynamic illnesses. Improved biomarker search and use strategies using complexity and commensurable theories can help globally to save millions of lives and billions of costs.

Complexity sciences advantages are cited:

1. dynamic data biomarkers can replace typical static measures biomarker– averages, threshold, point;
2. Unified simplified analytics across body dimensions
3. improved theoretical foundations for a new unifying and simplifying General Ontology of Human beings.

Dominant approaches disadvantages are cited

1. static or point measures inadequate to body dynamics
2. limits to clinical and remote medicine use
3. high costs often limit biomarker diffusion.

Paths forward are described: evidence bases, freeware, public domain analytics, references -- to enable exploring this sector-wide biomarker approach.

Panel – Advances in Medicine, Policy and Leadership Inspired by Complexity Science

MODERATOR: Paige McDonald

Friday, October 27, 2017

Pines and Carr	Complex Systems Thinking in Acute and Emergency Care
Hazy	What Leaders Should Know About Complexity (And Why Knowing This Will Make You a More Effective leader)
Seely	

Complex Systems Thinking in Acute and Emergency Care

Jesse Pines(a) **and Brendan G. Carr**(b)

(a) **Department of Health Policy and Management**
George Washington University, Washington, DC, USA
jpines@mfa.gwu.edu
(b) **Department of Emergency Medicine**
Thomas Jefferson University, Philadelphia, PA, USA
brendancarr@gmail.com

The specialty of emergency medicine is experiencing the convergence of a number of transformational forces in the United States, including healthcare reform, technological advancements, and societal shifts. These bring both opportunity and uncertainty. Persistent challenges such as the opioid epidemic, rising healthcare costs, misaligned incentives, patients with multiple chronic diseases, and emergency department crowding continue to plague the acute, unscheduled care system. The traditional approach to healthcare practice and improvement - reductionism - is not adequate for the complexity of the twenty-first century. Reductionist thinking will likely continue to produce unintended consequences and suboptimal outcomes. Complex Systems Thinking provides a perspective and set of tools better suited for the challenges and opportunities facing public health in general, and emergency medicine more specifically. This session will introduce complex systems thinking and argues for its application in the context of emergency medicine and by providing examples of its application to several practice challenges.

What Leaders Should Know About Complexity (And Why Knowing This Will Make You a More Effective leader)

James K. Hazy

Robert B. Willumstad School of Business
Adelphi University, New York, NY, USA
hazy@adelphi.edu

This talk is intended to help participants provide thoughtful and effective leadership under conditions of extreme complexity. It interweaves three themes that build a conceptual foundation from which one can successfully orchestrate an organization's activities and by doing so achieve personal success. The themes clarify: 1) how the term "complexity" in science differs from "complex" in common usage, 2) how these ideas inform life in today's complex organizations, and 3) how individuals can use these ideas to become more effective leaders.

Complexity leadership approaches are distinct from traditional leadership studies. This is because traditional approaches explore how a leader activates a follower to move in a desired direction, but they are agnostic about the direction. In contrast, complexity leadership is interested in the process of identifying, framing and moving the system in the right direction as defined by the organization's purposes. The implicit premise is that organizations, and the people within them, must continually acquire and process the resources that are needed while also adapting to changing circumstances under uncertainty. Thus, the hard part of leadership is figuring out what needs to be done and who should do what. Once the way forward is identified, traditional leadership approaches can be applied according to the needs of the organization.

Complexity implies that a leader must shepherd others along a collective leadership journey through fine-grained complexity to discover the coarse-grained simplicity on the other side. To do this, leadership must perform three distinct functions each of which leverages a distinct type of influence. First, generative leadership actualizes models with various levels of descriptive complexity to frame and enact coarse-grained outcomes. Leaders do this by exerting informational influence. Second, community-building leadership legitimizes structural attractors to enact cooperative activities. Leaders who do this use normative influence to draw people together and enable cooperation. Finally, administrative leadership reinforces or dampens various routines and capabilities to enable continuing and effective execution. Leaders do this by exerting incentive and coercive influence. Each of these types is illustrated through examples.

Mini-TED Talks 2
MODERATOR: Randy Thompson

Friday, October 27, 2017

Harper	OR Saves Lives!
Jones	Can Salutogenesis Work in the US?
Martin	Resilience – a preliminary exploration of a theoretical framework of non-linear stability. Individual health journeys and health systems
Lotrecchianoa, Kane, Zocchi, Gosa, Lazar and Pines	Bringing Voice in Policy Building: A Cross Population Multi-Stakeholder Conceptual Model or Management of Acute Unscheduled Care in the United States Using Group Concept Mapping
Liu, Ye, Armstrong and Heng	Stress induced variants through genome-environment interaction: The general mechanism of diseases
Topolski	Health complexity loss in addiction

OR Saves Lives!

Paul Harper

School of Mathematics
Cardiff University, Wales, United Kingdom
harper@cardiff.ac.uk

Healthcare systems are stochastic in nature; that is they typically operate in an environment of uncertainty and variability, both at scale and within highly complex and connected networks. Furthermore, many healthcare services are under significant pressure to deliver more with less. With Operational Research (OR) methods we can build mathematical based models of current processes and use them to explore “what if?” scenarios to evaluate the likely consequence of different ways of working whilst incorporating the stochasticity and complexity, and move towards optimally configured services. This is much safer than experimenting with changes to the system for real and seeing what happens. Literally it can help save lives, for example in one major hospital our research completely redesigned the care for stroke patients, which resulted in a reduction in mortality rates by 60%. In another hospital emergency department, our work helped to save the Health Board £1.6m per year through optimised capacity planning.

This short talk will highlight some of the applicable OR methods with recent case studies and future challenges. An exciting initiative here in Wales has been the creation of a Healthcare Modelling Unit funded by the Aneurin Bevan University Health Board (ABUHB) and Cardiff University. The unit consists of researchers who are the first of a new generation of modellers to be embedded within the NHS Wales.

Can Salutogenesis Work in the US?

Alonzo Jones

Common Sense Medicine
Plainview, TX, USA
drjones@commonsensemedicine.org

Health should be the goal of a health care system. The concept of Salutogenesis–what are the foundations of good health for the individual–was pioneered by Aaron Antonovsky while he was at Stanford more than 40 years ago, but it is largely invisible in our mostly analytical disease based care system.

Antonovsky's conclusions were that people tended to have better health if they had what he called a Sense of Coherence (SOC). That is when a person sees their environment as comprehensible, manageable, and meaningful. Comprehension is enhanced by communities with a common problem sharing information and coping methods, as Tom Insel is doing with mental illness. Manageability is mostly being able to pay for the care we get. Meaningfulness is a feeling that coping with the problems of life is worth the effort. It comes from sharing stories with others and has a great deal to do with how we adapt in healthier ways.

This is not an analytical framework despite the reliable value of the SOC scale in demonstrating its accuracy. It is best understood when looking at people as both complex and adaptive. Genetic adaptation is our current focus and with CRISPR we can speed it up; but doing so is likely rife with unintended consequences because of our genetic complexity. But memetic adaptation, having to do with our individual and social ideas, follows the same evolutionary rules as we adapt to our environments, but occurs much faster. This kind of adaptation is central to Salutogenesis and the key is creating a more friendly environment.

This is currently being done in the United States, although without recognition of its Salutogenic framework. Two examples include our own experiences as well as those of Tom Insel who left his job as the head of NIMH to work at Google, and now at Mindstrong, to create virtual communities designed to help those with mental illnesses.

In order to create a Salutogenic health care system several elements need consideration. The problems with our current analytical care system are what prompted this group to come together. Central in our vision is that we and our systems are both complex and adaptive in a memetic sense, and that our memes affect our health. Adaptation occurs in limited ways when the organism is threatened, but if it is not threatened it is fully within reason that adaptation can be nudged in a preventive, Salutogenic, direction.

Resilience – a preliminary exploration of a theoretical framework of non-linear stability. Individual health journeys and health systems

Carmel Martin

General Medicine Program
Monash Health, Melbourne, Australia
carmelmarymartin@gmail.com

Background. System resilience reflects attributes that govern the system's dynamics. Three related attributes of individual health journeys and health systems (IHHSs) may determine their future trajectories: resilience, adaptability, and transformability.

Aims. This presentation will interrogate the concepts of resilience, adaptability and transformability in the context of individual journeys and health service journeys in the MonashWatch program, based on an adapted theoretical framework of Walker et al. [1] . It will also explore the application to IHHS based on conceptual and empirical work on Dynamic Indicators of Resilience (DIORs). Marten Scheffer et Al [2] .

Theoretical Framework. Resilience is the capacity of an IHHS to absorb disturbance and reorganize while undergoing change to still retain the same essential function, structure, identity, and feedback mechanisms. Resilience has four components—latitude, resistance, precariousness, and panarchy (whole system behavior).

Latitude is the maximum amount a system can be changed before losing its ability to recover (before crossing a threshold which, if breached, makes recovery difficult or impossible).
Resistance is the ease or difficulty of changing the system; how "resistant" it is to be changed.
Precariousness is how close the current state of the system is to a limit or "threshold."
Panarchy: the resilience of a system at a focal scale will depend on the influences from states and dynamics at scales above and below. For example, politics, state and federal funding models, or weather change can trigger local surprises and shifts in IHHSs.
Adaptability is the capacity of actors in the system to influence resilience (in a HHS, essentially to manage it).
Transformability is the capacity to create a fundamentally new system when HHS structures make the existing system untenable [3].

Key Findings. The stability landscape provides a useful metaphor. An inherent difficulty in the application of resilience concepts is that they are abstract. Thus, there is confusion in their practical use. Scheffer and other researchers are beginning to operationalize DIORS in frailty and depression, for example. Little attention has been given to 'potentially avoidable hospitalizations in adults'. A potential theoretical framework is proposed with 3 cases from a clinical program

Conclusions. Resilience analysis is a field ripe for exploitation in IHHS.

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2. (2017) Quantifying Systemic Resilience. The new frontier in human and animal health. In press
3. Walker, B., et al. (2004) Resilience, adaptability and transformability in social–ecological systems. 9(2): 5. Ecology and Society

Bringing Voice in Policy Building: A Cross Population Multi-Stakeholder Conceptual Model or Management of Acute Unscheduled Care in the United States Using Group Concept Mapping

Gaetano R. Lotrecchianoa(a,b), **Mary Kane**(c), **Mark S. Zocchi**(c), **Jessica Gosa**(c), **Danielle Lazar**(d) **and Jesse M. Pines**(b,c)

(a) **George Washington University, Department of Clinical Research and Leadership, Washington, DC, USA**
(b) **George Washington University, Center for Healthcare Innovation and Policy Research, Washington, DC, USA**
(c) **Concept Systems Incorporated, Ithaca, NY, USA**
(d) **Consulting Solutions at Envision Pharma Group, Philadelphia, PA, USA**
(e) **George Washington University, Departments of Emergency Medicine and Health Policy, Washington, DC, USA**
glotrecc@GWU.edu

Purpose. This paper describes the use of Group Concept Mapping (GCM) as a tool for developing a conceptual model of an episode of acute, unscheduled care from illness or injury to outcomes such as recovery, death, and chronic illness.

Design/methodology/approach. After generating a literature review drafting an initial conceptual model, GCM software (CSGlobal MAXTM) is used to organize and identify strengths and directionality between concepts generated through feedback about the model from several stakeholder groups: acute care and non-acute care providers, patients, payers, and policy makers. Through online and in-person population specific focus groups the GCM approach seeks feedback, assigned relationships and articulated priorities from participants to produce an output map that described overarching concepts and relationships within and across sub samples.

Findings. A clustered concept map made up of relational data points that produced a taxonomy of feedback used to update the model for use in soliciting additional feedback from two technical expert panels and finally, a public comment exercise is utilized. The results are a stakeholder-informed improved model for an acute care episode, identified factors that influence process and outcomes, and policy recommendations delivered to the DHHS Assistant Secretary for Preparedness and Response.

Practical implications. This study provides an example of the value of cross-population multistakeholder input to increase voice in shared problem health stakeholder groups.

Originality/value. This paper provides GCM results and a visual analysis of the relational characteristics both within and across sub-populations involved in the study. It also provides an assessment of observational key factors supporting how different stakeholder voices can be integrated to inform model development and policy recommendations.

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Stress induced variants through genome-environment interaction: The general mechanism of diseases

Guo Liu (a)**, Christine Ye** (b)**, Zachary Armstrong** (a) **and Henry H Heng** (a)

(a) **Wayne State University School of Medicine, Detroit, MI, USA**
(b) **University of Michigan School of Medicine, Ann Arbor, MI, USA**
gliu@med.wayne.edu

While it is generally accepted that various environmental stresses play an important role in disease's etiology and treatment response, it has been challenging to establish a common theory that integrates stress-induced cellular adaption/cell death, genotype/environment interaction, and emergent phenotype during the evolutionary process. Difficult tasks include making sense of the highly diverse relationship between genotype and phenotype observed from both patients and normal controls, understanding the switching among specific molecular specificities documented in stress response pathways, as well as illustrating the mechanism of how the same stressor or stress response pathways can be linked to various diseases. In this paper, by searching and redefining the common basis of various specific stress responses, we aim to illustrate the general mechanism of many common and complex diseases. In particular, we propose the idea that stress response serves as a key mechanism for genotype environment interaction. To articulate this idea, we first link various types of stress response to a common mechanism of maintaining system homeostasis. One important means is to generate cellular diversity, the needed evolutionary potential for adaptation. As a trade-off for such beneficial changes, the system pays the price. This leads to the increased disease potential, reflected by the increased variants that do not fit the current environment. We then study how different types of stress and stress responses can change the overall cellular evolutionary dynamics, and interact with fuzzy inheritance to produce disease phenotypes following heterogeneity-mediated emergent properties. This evolutionary model that integrates the stress-mediated interaction of genotypes and environments will likely unify the diverse molecular studies in the field of stress research, and benefit both the understanding and monitoring of stress for many common and complex diseases.

References

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Health complexity loss in addiction

Stefan Topolski

Founder and Director of Trailside Health
Shelburne Falls, MA, USA
public@cottagemed.org

Purpose. To apply definitions of health complexity to improve the understanding of the relative disease severity of illness among individuals with a diagnosis of addiction.

Method. Qualitative and semi-quantitative definitions of health in the complex sciences literature [Sturmberg, Topolski, et al.] are applied to published health self-assessments by individuals who suffer severe addiction or severe locked-in syndrome, respectively.

Results. Individuals with the profound physical debility of locked-in syndrome appear to report more complex stronger family and community social support with emotional health while individuals with severe addiction appear to have less complex disrupted, lost, or lacked family or community support networks. Individuals with locked-in syndrome report higher subjective personal assessments of their overall health than do individuals suffering with addiction. Physical and emotional responses of individuals with addiction appear to be more predictable and stereotypical, i.e. less complex, than those of individuals with locked-in syndrome. The physical disability of individuals with severe addiction can begin to resemble the marked physical disability and mortality rates of individuals withlocked-in syndrome. Addiction may constrain volitional activity to a degree comparable with locked-in syndrome.

Conclusion. Quantitative, qualitative, subjective and objective measures of lost health complexity may be more than previously appreciated among individuals with severe addiction. The illness and disability of severe addiction may have the potential to approach or exceed the disability and suffering of individuals with profoundly physically disabling locked-in syndrome. Appreciating a complex systems approach to understanding and defining illness may produce an unexpected and paradoxical result to accepted wisdom in the physician assessment of human illness from addiction.

REFERENCES
Sturmberg

Graduate Student Research Projects

MODERATOR: Gaetano R. Lotrecchiano

Friday, October 27, 2017

Matta and Paina	Using Simulations as Teaching Tools to Better Understand Complex Health Systems
Chen	Impact Analysis of Complexity Science Modelling Techniques in Health Care: A Mixed-Method Research Proposal
Priyanka, Joshi and Ciemins	Hypertension (HTN) Prevalence Disparities for Predicted and Diagnosed HTN in African Americans & Caucasians: A Longitudinal Ecological Epidemiology Study
Weaver	Complexity Science and Cognitive Interventions for TBI
Barry, Sheffey and Mohamed	Understanding the Complexity of Stakeholder Needs: Ethical Conduct Prioritizations for Clinical Trials in Low-Middle Income Countries
Lim, Wenting and Camorlinga	A study on the modeling for childhood obesity

Using Simulations as Teaching Tools to Better Understand Complex Health Systems

Sasmira Matta and Ligia Paina

Johns Hopkins Bloomberg School of Public Health, Department of International Health
Baltimore, MD, USA
smatta1@jhu.edu lpaina@jhu.edu

Systems thinking (ST) is a key competence of health systems researchers, program implementers, and decision-makers. Though critical, it proves to be challenging because it is hard to visualize how moving parts interact to influence a particular outcome. As a result, ST is difficult to learn from a textbook. However, simulations can be used to encourage learning ST and can provide an opportunity for students and decision-makers to apply ST in a fun and interactive way.

Simulations are the end result of system dynamics modeling (SDM). System dynamics modeling is a method of developing computer-simulated models to visualize the processes of accumulation and feedback of complex interactions. SDM allows public health practitioners to hone in on the interplay between behavioral, technical, quantitative variables, and political and cultural issues—yielding valuable insights that would not be apparent in a less integrated approach. These computer models allow public health practitioners to approach an issue from multiple facets, to see connections between disease outcomes, risk behaviors, environmental factors, and health resources and delivery. Additionally, SDM allows for the inspection of health phenomena, which is often nonlinear and deviates from normality.

The Forio software translates the models into a user friendly interface and allows students and decision makers to test “what if” and “why” by differing the inputs, and helps users understand an outcome allowing for making reasonable and achievable goals for the future. Therefore, simulations have a large potential in developing the ST capacity of decision-making tackling complex issues in low and middle-income countries.

This presentation will guide the audience though a Forio project to simulate policies for tobacco control. We will reflect on the role of simulations in learning how to tackle complex health issues and how to best prepare the next generation of health professionals to understand use complexity and systems sciences.

Impact Analysis of Complexity Science Modelling Techniques in Health Care: A Mixed-Method Research Proposal

Junqiao Chen

ISCTE – University Institute of Lisbon
Evolent Health
junqiao.chen@kellogg.ox.ac.uk

Background. Despite the wide endorsement and growing publication in applying CS modelling techniques in healthcare, evidence of their actual impact is lacking. From preliminary search, no model has been evaluated or adopted by peer researchers. Also, there is no guidance on incorporating “in silico evidence” into clinical guidelines or change in practice. For example, two modelling studies have suggested to extend the retinal screening intervals for diabetics. However, leading guidelines either reserves the annual screening recommendation, or changes it to biennial by citing empirical evidence instead. Thus how useful these studies are to decision makers is unknown.

Aim. To understand in what subject areas and in what ways that complexity science modelling techniques have informed the development of clinical guidelines or changes in practice (e.g., a quality improvement project). If they are not informative, then why.

Method. This will be a two-stage mixed-method research. First, using keywords such as “differential equations”, “stochastic models”, “cellular automata” and “agent-based model”, literature would be systematically reviewed to summarize all relevant articles and their subject areas. Two published reviews could accelerate this step in the area of chronic diseases. Second, citations will be forward tracked to identify projects informed by these studies. A simple measurement tool would be developed to analyse these projects, categorizing in what way the modelling studies are informative. If a modelling study is never cited, literature published after it will be searched to identify projects that overlap with its subject area. Then surveys will be sent to the project leads on whether they realized the existence of such publication and the reason of not considering it. Conclusion will be drawn based on data collected from the measurement tool and the survey.

Hypertension (HTN) Prevalence Disparities for Predicted and Diagnosed HTN in African Americans & Caucasians: A Longitudinal Ecological Epidemiology Study

Surio Priyanka, Vaishali Joshi and Elizabeth Ciemins

George Washington University and American Medical Group Association (AMGA) Analytics Washington, DC, USA
psurio@gwmail.gwu.edu

Background/Purpose. In 2012 persistent high blood pressure (BP), diagnosed as HTN, impacted 33.3 million U.S. adults. African Americans have the highest prevalence of HTN (42.1%) & uncontrolled BP. Health systems may be missing opportunities to diagnose patients with HTN.

Objectives. Comparing African Americans and Caucasians, identify differences in diagnosed HTN prevalence with evidence of uncontrolled BP; and predicted and diagnosed HTN prevalence using CDC's HTN prevalence estimator.

Methods. Data from 4.26M patients representing five medical groups with varying levels of racial diversity were included in this study. Uncontrolled BP and diagnosed HTN with clinical evidence were stratified by race and compared over time. Regression models controlled for sex, age, number comorbidities, and ambulatory visits. Using CDC's HTN estimator tool taking into account sex, age group, race, and comorbidity status, predicted HTN prevalence was compared to diagnosed prevalence as determined by a medical claim, and/or EHR patient problem list. Patients with clinical evidence of HTN, but without documentation were also identified.

Results/Outcomes. From 2012-2015, 45% of African Americans had uncontrolled BP compared to 36.1% of Caucasians (OR 1.5; $p<0.05$). Independent predictors of uncontrolled HTN included greater age, and an increased number of comorbidities and ambulatory visits. African Americans were 1.9 times as likely to have a HTN diagnosis with evidence of uncontrolled BP when compared to Caucasians across all four reporting periods ($p<0.05$). Predicted HTN prevalence (32.7% Caucasians; 50.7% African Americans) was lower than diagnosed HTN prevalence when compared to evidence on medical claims and problem lists (40.2% Caucasians; 51.7% African Americans) and higher than diagnosed HTN using evidence from problem lists only.

Conclusions. Accuracy in diagnosed HTN prevalence may improve when multiple evidence sources are examined (i.e., medical claims, patient problem list, and BP readings). When applied to a large population dataset, the CDC estimator tool provided a conservative estimate for HTN. Differences in predicted vs. diagnosed prevalence were smaller for African Americans than Caucasians. Findings from the estimator tool may help health systems identify under-diagnosed patient populations.

Complexity Science and Cognitive Interventions for TBI

Jennifer Weaver

The George Washington University
Washington, DC, USA
jenweaver524@gwu.edu

Complexity science offers a systems perspective that considers how unpredictability within the health care system may influence a person's health outcomes (1, 2). We conducted a systematic review of occupational therapy interventions targeting cognition in individuals with Traumatic Brain Injury (TBI) to determine if interventions that incorporate key characteristics of complex adaptive systems (CAS) are associated with better outcomes.

We searched PubMed for intervention studies published within the last 5 years. Our initial 1,465 articles yielded inclusion of 31 articles in the analysis. Following Leykum et al.'s (2010) methodology, two reviewers (blinded to study results) assessed the intervention for key characteristics of CAS: agents who learn, interconnections, self-organization, and co-evolution (3, 4). One point was awarded for each component incorporated into the intervention (0=poor integration of CAS, 4=strong integration). Another reviewer scored the effectiveness of the intervention using criteria established by Leykum et al. (2010): 0=non-significant outcomes; 0.5=trending towards significance; 1=significant outcomes (3, 4). We analyzed 3X4 cross-tabulation frequencies of each of the effectiveness scores and each of the CAS scores. Generally, as the CAS rating score increased, the frequency of studies with effective results also increased. While this does not appear to be a strong relationship, there is a trend in this direction.

Our results indicate that there may be a relationship between intervention effectiveness and the integration of CAS characteristics within those interventions. This would indicate that interventions using a simplistic approach may not be as effective as those that provide flexibility to adapt the intervention when provided within a complex adaptive system. Further exploration is warranted to demonstrate the significance of these results among a greater number of interventions. More work is also indicated in refining the measurement of complex aspects of health within the context of occupational therapy interventions.

References

Understanding the Complexity of Stakeholder Needs: Ethical Conduct Prioritizations for Clinical Trials in Low-Middle Income Countries

Romiya G. Barry(a)**, Landria Sheffey**(a) **and Anab Mohamed**(b)

(a) **The George Washington University, Washington, DC, USA**
(a) **Walden University, Minneapolis, MN, USA**
romiya_barry@gwu.edu

The private sector can do much to support the Sustainable Development Goals initiative in lowmiddle income countries (LMICs) through investments in research and development for pharmaceuticals, medical devices, and other health interventions. These investments present opportunities for cross-sector collaborations between researchers, policy-makers, academicians, and private sector industry. Yet, they also present challenges in balancing the primacy research needs of implementing organizations with their moral, social, and political obligations. The complexity of stakeholder interactions required to achieve ethical conduct of clinical trials within these contexts requires further research to identify potential competing priorities and needs, which may serve as barriers to innovation. Identifying potential conflicts and tensions among stakeholder priorities is critical prior to the conduct of clinical trials in LMICs. This presentation discusses the results of a scoping review to systematically identify and characterize the underpinning ethical research priorities of implementing clinical trials in LMICs. In recognition of the influence of cultural complexity on collaboration and practicalities, the scoping review aims to identify the stakeholder associations represented within the literature to evaluate the influence that identified factors and their interdependencies have on the ethical conduct prioritizations for international research in LMICs. Knowledge gained from this scoping review will not only highlight potential conflicts between among stakeholders involved in initiating clinical research programs in LMIC, but it may also reveal ways to maximize benefits for research participants and to implement solutions to address potential barriers to innovation.

A study on the modeling for childhood obesity

Sung Young Lim, Shi Wenting and Sergio G. Camorlinga

University of Winnipeg
Winnipeg, MB, Canada
lim-s6@webmail.uwinnipeg.ca

According to the World Health Organization, the number of childhood obesity increased from 31.5million globally in 1990 to 40.6 million on 2016. There is a high possibility that obese children will grow up to be adults who are still obese. Also, they are more likely to have a variety of serious health problems as adults. If these circumstances persist, the financial burden of supporting obese people will place heavy pressure on healthcare expenditure. To solve this problem, it is very important to find out what are the causes of childhood obesity. In this study, we have identified a variety of factors that are grouped in economic factors, government policies, social attitudes, school environment, neighborhood environment, family influences, psychological factors, genetic factors and screen time. Currently,the model is being implemented as a NetLogo multi-agent model. The model is based on complex adaptive systems that can simulate obesity rates. Most of the previous modeling approaches are focused on one risk factor but this model can use various risk factors. To find out which factor affects childhood obesity, the model sets several risk factors which affect the obesity, and the user can choose what risk factors to manipulate and determine what percent of these factors are affecting obesity. Comparing the results of this model and existing statistical data, people can find out which factors are the most relevant affecting childhood obesity. Finding out the main factors affecting childhood obesity will help to reduce childhood obesity and cut down the cost of preventing and curing childhood obesity.

Posters

Friday, October 27, 2017

Gonnering and Riley	The Paradoxical “Hispanic Paradox”: The Dark Side of Acculturation
Reens	Optimising Operating Room Efficiency

The Paradoxical “Hispanic Paradox”: The Dark Side of Acculturation

Russell Gonnering and William Riley

School for the Science of Health Care Delivery
Arizona State University, Phoenix, AZ, USA
Russell.Gonnering@asu.edu William.J.Riley@asu.edu

Since first described by Markides and Coreil in 1986, multiple authors have attempted to unravel the curious finding that Hispanic Americans appear to, in spite of seemingly disadvantageous health factors, to have better outcomes than expected. While there have been some dissenting studies, the preponderance of evidence seems to support the finding, although the exact mechanism remains elusive. A computational analysis of the 2011-2016 data on the counties of Arizona and New Mexico contained in the Robert Wood Johnson Foundation’s County Health Rankings and Roadmaps confirmed that this Hispanic Paradox does indeed exist. However additional factors, such as the distribution and concentration of the Hispanic population, appear to be necessary in order for it to manifest. It is maximized once a critical level of population percentage and lack of acculturation are met. These levels are achieved in some counties in Arizona, but are absent in New Mexico, despite an average county Hispanic population percentage only 60% that seen in New Mexico. In this regard, the Hispanic Paradox appears to follow the same dynamics as that seen in the Roseto Effect described in the 1960’s and may be related to the differing effect of curanderismo in these areas.

Optimising Operating Room Efficiency

Michael Reens

mreens619@gmail.com

Operating Room expenditures represent a large proportion of the total spending within a healthcare institution. Delays in turn-over times cost hospitals millions of dollars in lost revenue annually (Friedman et al. 2006). With the combination of drastically rising costs of healthcare and cuts in reimbursement, hospitals and healthcare systems are seeking ways to improve operating room efficiency to meet the demand for high quality, cost efficient healthcare. The purpose of this project is to determine the extent to which the implementation of remote video monitoring improves operating room staff efficiency, which may reduce turn over time and offer financial gain for an institution. Using retrospective data, an analysis will be conducted in a leading healthcare institution in the suburban north east of the United States. Data analysis will include: the time intervals from when a patient exits the room to the start of room cleaning; the time from the end of room cleaning to the time of room sterility, and the time from room sterility to the entrance of the next patient. Data prior to remote video monitoring will establish baselines for the time intervals, and an analysis at 1 month, 3 month, 6 month, and 12 month post implementation will be conducted A paired T test will be utilized to analyze data. Anticipated outcomes include a reduction in turn-over times, which will allow for an increase in prescheduled case volume and/or a reduction in staff overtime expenditure, both leading to financial gain for the institution.

Mini-TED Talks 3 - Physiology Stream

MODERATOR: Joachim Sturmberg

Friday, October 27, 2017

Rohleder	Mechanisms of habituation of inflammatory responses to repeated acute stress and its role in health and disease
Seely	Origins of degree and complexity of variation inherent to complex systems
Suki	Elastic Network Models of Tissue Failure: Implications for Treatments of Emphysema
Heng, Liu, Alemara and Ye	The mechanisms of how genomic heterogeneity impacts bio-emergent properties: the challenges for precision medicine
Camorlinga	Complex Adaptive Systems in the Brain
Barnaby	Predictive Modeling with Heart Rate Variability, Clinical and Laboratory Measures to Predict Future Deterioration in Patients Presenting with Sepsis

Mechanisms of habituation of inflammatory responses to repeated acute stress and its role in health and disease

Nicolas Rohleder

Friedrich-Alexander-University Erlangen-Nürnberg
Erlangen, Germany
nicolas.rohleder@fau.de

Background. Stress has long been identified as a contributor to disease. While research on chronic stress has helped identify pathophysiological mechanisms, such as altered stress system activity and low-grade inflammation, less is known about the contribution of repeated acute stress events. Acute stress exposure is likely to play a role for long-term health, and to explain the transition from acute to chronic stress, but determinants of responses to repeated stress are understudied.

Methods. We investigated a sample of more than 60 healthy participants exposed to the Trier Social Stress Test (TSST) twice on consecutive days. Blood and saliva samples were taken repeatedly before and after, and self-reports of psychological traits and states were obtained. Stress and inflammatory system indicators were obtained from biological samples, and determinants of habituation versus sensitization of were analyzed.

Results. Results showed significant stress responses of all biomarkers assessed, including salivary cortisol and alpha-amylase, interleukin-6, as well as selected transcripts related with inflammatory regulation. Habituation was found for cortisol and gene expression; non-habituation was found for IL-6. While few relationships emerged with responses to initial stress, analyses revealed that indicators of adverse psychological conditions were related with non-habituation or sensitization.

Conclusions. Our results support the notion that repeated stress exposures are required to uncover relationships of acute stress responses with self-reported psychological status. Results are further in line with predictions made by the allostatic load model about the role of maladaptive stress response patterns. Future studies will have to test whether maladaptive patterns are able to predict long-term health.

Origins of degree and complexity of variation inherent to complex systems

Andrew Seely

Ottawa Research Institute
Ottawa, ON, Canada
ajeseely@gmail.com

Complex systems have common defining characteristics, including emergent properties, stability and uncertainty, and complexity in space and time. The complexity involves multi-scale self-similarity or fractal characteristics, within finite limits. For example, the patterns of variation of physiologic parameters, such as heart and respiratory rate variability, and their alteration with age and illness have long been under investigation; however, the origin and significance of scale-invariant fractal temporal structures that characterize healthy biologic variability remain unknown. Independently, atmospheric and planetary scientists have led new understanding exploring non-equilibrium thermodynamics of far-from equilibrium systems. We aim to provide two novel hypotheses regarding the origin and etiology of both the degree of variability and its fractal properties. In a complex dissipative system, we hypothesize that the degree of variability reflects the adaptability of the system and is proportional to maximum work output possible divided by resting work output. Reductions in maximal work output (and oxygen consumption) or elevation in resting work output (or oxygen consumption) will thus reduce overall degree of variability. Second, we hypothesize that the complex fractal nature of variability is a self-organizing emergent property of complex dissipative systems, precisely because it enables the system's ability to optimally dissipate energy gradients and maximize entropy production. In physiologic terms, fractal patterns in space (e.g., fractal vasculature) or time (e.g., cardiopulmonary variability) optimize the ability to deliver oxygen and clear carbon dioxide and waste. As our focus is bedside utility to help patients, potential clinical applications of this understanding merit further research and development.

Elastic Network Models of Tissue Failure: Implications for Treatments of Emphysema

Bela Suki

Department of Biomedical Engineering
Boston University, Boston, MA, USA
bsuki@bu.edu

Damage and mechanical failure of soft tissues can lead to diseases and life threatening conditions including the failure of prosthetic heart valves, capillary stress failure, tissue destruction in pulmonary emphysema, and vessel wall aneurysms. Microscale damage occurs when mechanical forces in the tissue are sufficiently high to rupture intercellular connections or enzymatically weakened extracellular matrix elements. When the microscale damage reaches a critical amount, tissue or organ failure can happen. In this presentation, we first briefly review the failure of the main constituents of tissues including molecules, cells, elastin, collagen, and proteoglycans. We then discuss failure of tissues modeled as complex elastic networks. We show that when fibers percolates the tissue, the network failure is dominated by failure of individual fibers. When the main fiber component does not percolate, the failure stress of the network is still determined by fiber stiffness, but its failure strain emerges as a network phenomenon. As an example, we will apply a network model to evaluate the efficacy of two medical interventions used to treat emphysema, lung volume reduction surgery (LVRS) and bronchoscopic lung volume reduction (bLVR). Analysis of network behavior shows that (1) LVRS efficacy can be predicted based on pre-surgical network structure; (2) macroscopic functional improvements following bLVR are related to microscopic changes in mechanical force heterogeneity; and (3) both techniques improve aspects of survival and quality of life, albeit while accelerating disease progression. In conclusion, network approaches to tissue and organ function can yield unique insights into the microscopic origins underlying disease progression as well as response to medical treatments.

The mechanisms of how genomic heterogeneity impacts bio-emergent properties: the challenges for precision medicine

Henry H Heng(a)**, Guo Liu**(a)**, Sarah Alemara**(a)**, Christine J Ye**(b)

(a) **Wayne State University School of Medicine, Detroit, MI, USA**
(b) **University of Michigan School of Medicine, Ann Arbor, MI, USA**
hheng@med.wayne.edu

While the promise of precision medicine has generated excitement and high expectations, there are challenges for some key assumptions on which the concept is based. Since most common and complex diseases belong to adaptive systems where fuzzy inheritance interacts with the dynamic environment during non-linear somatic cell evolution, both disease progression and treatment response are less predictable if only based on precision of gene profiles. Even though increased voices have expressed their concerns on this neo-reductionist approach (reduction based on big data), few have directly studied the conceptual limitation of precision medicine. In this paper, we will analyze how bio-heterogeneity shapes inheritance itself, and interacts with cellular environments to impact the emergent properties of diseases. In particular, the importance of karyotype alterations in somatic cell evolution will be briefly discussed in the context of cellular adaptation, based on the redefinition of a genetic blueprint, which is encoded by the genome rather than individual genes. By illustrating how different features of heterogeneity lead to different emergent properties (from gene expression and cellular population behavior to disease response), we identify a number of patterns of heterogeneity that contribute to unexpected bio-emergent properties. We further conclude that bio-heterogeneity acts as a main determinant factor that alters the pattern of emergent properties crucial to adaptation and/or diseases and treatment responses. The dynamic interaction of heterogeneity in lower level agents (such as genetic elements and environments) leads to the unpredictability of the complex adaptive system. As a result, stress-induced multiple genomic heterogeneity-mediated evolutionary processes likely represent the biggest challenge for precision medicine. Our analyses also provide genome evolution based explanations to the issue of missing inheritability.

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Complex Adaptive Systems in the Brain

Sergio G. Camorlinga

University of Winnipeg
Winnipeg, MB, Canada
s.camorlinga@uwinnipeg.ca

There is no doubt of the magnificent capacity of the human brain. Billions of neurons, glia and other cells form a multitude of brain systems that provide sensory and motor capabilities, and the behaviour mechanisms that characterize human beings among many other things. There are different perspectives and levels to study the brain as a conglomerate of complex adaptive systems (CAS). A key aspect of the brain capabilities and mechanisms is that they are continuously emerging from the activities of multitude of cells participating in each system, self-adapting to the changing environmental conditions present inside and outside the human body all the time.

Our research contrast with artificial neural networks (ANN), which although they are inspired on biological neural systems, ANNs are engineering systems tune to solve an specific problem (e.g. face recognition). Our work is concerned with the computational modeling of neural systems with the use of CAS models based on multi-agent systems. This approach has some benefits like for instance the identification of neural processes supporting the emergence of sensory and motor capabilities, which help in their understanding and their disease management, but also provide insights to use these mechanisms to design better and improved distributed systems for computing networks.

This presentation focuses on the description of several CAS in sensory and motor systems like the large number of neurons that use population coding to represent sensory, motor, or cognitive information and emerging with a distributed property of a stimulus such as a taste, an olfaction, a voluntary movement, etc. These sensory and motor neuronal systems are a small sample of the existence of many CAS in our brain, continuously emerging with activity, self-adapting internally and externally to make a unique human being.

Predictive Modeling with Heart Rate Variability, Clinical and Laboratory Measures to Predict Future Deterioration in Patients Presenting with Sepsis

Douglas P. Barnaby

Department of Emergency Medicine
Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, NY, USA
dbarnaby@montefiore.org

Rationale. Identifying risk of future deterioration is critical to guide management and optimize disposition in Emergency Department (ED) patients with sepsis. Heart rate variability (HRV) is associated with presence and severity of infection, yet has not been evaluated with clinical and/or laboratory measures.

Objectives. To derive and evaluate performance of a predictive model combining clinical, laboratory and HRV measures to identify patients with sepsis at increased risk for future deterioration within 1-72 hours.

Methods. 1247 enrolled patients had clinical, laboratory values and ECG monitoring (>15 minutes) within 1hr of ED presentation, and were followed for 72 hours to identify clinical deterioration (defined as intubation, non-invasive ventilation, pressors/inotropes, ICU admission or death). Predictive modeling was performed on clinical, laboratory and HRV measures independently and collectively.

Measurements and Main Results. 832 patients had complete data, 68 (8%) of whom reached one or more endpoints. Optimal predictive performance was derived from a combination of HRV and laboratory values (AUC = 0.80, 95%CI: 0.65-0.92). This combination of variables was statistically superior to clinical (AUC = 0.69, 0.54-0.83), laboratory (AUC = 0.77, 0.63-0.90), and HRV measures (AUC = 0.76, 0.61-0.90) alone. Evaluating the combined HRV+laboratory model using sextiles, the high-risk group (17%) had a 3.7 (95%CI: 3.6-4.2) fold increase in risk of deterioration, whereas the low risk group (67%) had a <0.5 fold increase in risk of future deterioration.

Conclusions. A model combining HRV with laboratory values may help ED physicians evaluate risk of future deterioration in patients with sepsis.

Mini-TED Talks 4 - Patient Care Stream

MODERATOR: Peter Tsasis

Friday, October 27, 2017

Finegood	Complex is not the same as complicated: Frameworks and tools are needed to support application of systems thinking to complex health - related Challenges
Aron, Tseng, Soroka and Pogach	Balancing Measures: Identifying Unintended Consequences of Diabetes Quality Performance Measures
Carmack	Physician Burnout: A Public Health Crisis in Need of a Socio-Ecological Solution
Reventlow	Coordinated co-produced care for patients with complex health problems – an example from Denmark
Martin	Complex Adaptive Systems Approaches to Potentially Avoidable Hospitalizations. Implementing the Patient Journey Record System (PaJR) in Ireland and Australia
Katerndahl, Burge, Ferrer, Becho and Wood	Is perceived Need-for-Action among Women in Violent Relationships Nonlinear and, if so, why?

Complex is not the same as complicated: Frameworks and tools are needed to support application of systems thinking to complex health - related Challenges

Diane Finegood

Centre for Dialogue
Simon Fraser University, Burnaby, BC, Canada
finegood@sfu.ca

Over the last decade, efforts to present the complexity of health-related problems have been successful to the point at which many policy-makers have become familiar with the framing of challenges like obesity as complex(1). As an example, the Foresight obesity system map published in 2007 helped to enable dialogues that reflected this complexity and created opportunities for considering complex systems solutions (2). But as Wutzke et al have shown, most policy-makers do not yet see the value of embracing systems thinking in part because there is little evidence demonstrating that a systems approach is effective in addressing “wicked” problems like obesity and chronic disease prevention (1).

To advance the use of systems thinking and an evidence base regarding its value in health, we need to consider the application of systems thinking not only in the framing or defining of a problem, but also in the implementation of interventions, evaluation and synthesis of evidence. Currently available systems science tools like network mapping, causal loop diagrams and system dynamics are starting to help stakeholders frame problems as complex. Since problem and solution definition are the same activity in complex systems (3), systems thinking is starting to affect intervention planning, but there has been more limited effort to apply systems thinking to evaluation of interventions and to the synthesis of evaluative information (4). With new methods and tools, we can start to create an evidence base that policy makers can use to implement and evaluate systems approaches.

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Balancing Measures: Identifying Unintended Consequences of Diabetes Quality Performance Measures

David C. Aron(a) **, Chin-Lin Tseng**(b)**, Orysya Soroka**(b) **and Leonard M. Pogach**(c)

(a) **Louis Stokes VA Medical Center, Cleveland, OH, Case Western Reserve University School of Medicine, Cleveland, OH**
(b) **Department of Veterans Affairs-New Jersey Healthcare System, East Orange, NJ**
(c) **Office of Specialty Care Services, Dept. of Veterans Affairs, Wash., DC, USA**
david.aron@va.gov

Objective. To determine if changes in overtreatment rates were associated with changes in undertreatment rates.

Design. Pre-test/post-test study used cross-sectional administrative data from calendar years (CYs) 2013 and 2016.

Setting. The Veterans Health Administration.

Participants. Patients with diabetes at risk for hypoglycemia.

Intervention. Observational study of extant initiatives to reduce overtreatment.

Main Outcome Measures. Overtreatment rate of diabetes defined at the proportion of patients in the group at high risk for hypoglycemia with A1c<7.0%. Undertreatment defined as A1C>9%.

Results. There was marked variation in overtreatment rates; for A1c<7%, overtreatment rates ranged from 26.42% to 58.2% and 26.26% to 49.15% at the facility level in 2013 and 2016, respectively. The mean (±standard deviation (SD)) facility level overtreatment rates fell from 40.30 (±5.25)% in 2013 to 37.75 (±4.70)% in 2016 (p<0.001, paired t test). Facility undertreatment rates ranged from 5.76 to 16.86% and 6.80 to 18.68% at the facility level in 2013 and 2016, respectively. The mean (±SD) undertreatment rate rose from 10.32 (+2.21)% in 2013 to 11.04 (+2.38)% in 2016 (p=<0.001, paired t test). However, change at individual facilities ranged from a decrease of 4.59% to an increase of 7.16%. Within year correlations were stronger than between year correlations. Overtreatment defined as A1c<7 in this population inversely correlated strongly with undertreatment (r= -0.653, p<0.001).

Conclusions. Promotion of overtreatment reduction may be associated with an increase in undertreatment in patients with diabetes. Systems should include balancing measures to identify potential unintended harms.

Physician Burnout: A Public Health Crisis in Need of a Socio-Ecological Solution

Suzie Carmack

Health Communication Science SME, The MITRE Corporation, and
School of Integrative Studies and Dept. of Global and Community Health, GMU
McLean, VA, USA
scarmack@mitre.org

In this presentation, the issue of physician burnout will be explored as both a personal issue as well as a public health systems-level threat through an applied socio-ecological lens (Krugg, Dahlberg, Mercy and Lozano, 2002). The presenter will begin by briefly sharing her lived experience of discovering she had burnout when she began researching it. She will then offer an overview of the specific problem of physician burnout as more than just an individual's problem, but instead as a systems-level issue for both the cost and quality of healthcare delivery. As will be discussed, physician burnout has increased at an alarming 10% rate for the past 3 years in a row. As of 2016, 1 out of every 2 physicians (51%) reported frequent or constant feelings of burnout, and 2 out of every 3 resident physicians (50-75%) experienced burnout (American College of Physicians Wellness Champion Report, 2016). Burnout is defined as a "progressive loss of idealism, energy, and purpose experienced by people in the helping professions as a result of the conditions of their work." (Sanchez-Reilly, et. al, 2013) and there are three key characteristics of burnout: physical and emotional exhaustion, cynicism, and inefficacy (Maslach, Schaufeli, and Leiter, 2001). Physician burnout has been correlated with job dissatisfaction, less altruistic values, broken relationships, problematic alcohol use, and suicidal ideation (JAMA, 2012) and also threatens patient outcomes (due to medical errors, decreased physician empathy, increased physician unprofessional conduct, lower patient satisfaction and reduced patient adherence to treatment plans (Shanafelt ,2016; Dyrbye, et. al., 2008). Attendees will leave the session with both individual- and systems-level understandings of the rapid rise of physician burnout prevalence, as well as an expanded understanding of how intervention and policy design might address it.

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Coordinated co-produced care for patients with complex health problems – an example from Denmark

Susanne Reventlow

Research Unit for General Practice and Section of General Practice, Department of Public Health, University of Copenhagen, Denmark
susrew@sund.ku.dk

Background. Patients with severe mental illness constitute a vulnerable, high-risk group, having an excess mortality based on several factors, including the management of the patients' health problems and the coordination and communication. An earlier study from a randomised trial 'Diabetes Care in General Practice (DCGP) suggests that structured, individualised diabetes care in general practice (focusing on patients' situation, needs and capacity) markedly reduces mortality (NNT 3) among patients with diabetes and severe mental illness.

Aim. This study builds on the results from earlier studies and aims to create a coordinated care plan (a complex intervention) with individualised goals involving the patients' and all existing caregivers.

Methodology. The care plan will be developed based on interdisciplinary research. Qualitative and quantitative research methods will be used in a co-design process, involving the perspectives and experiences of all actors – both patients and professionals. Dialogue between professionals, patients and researchers will be employed as a systematic tool in this process.

Finally, the intervention will be tested in a cluster randomised, parallel-group, 5-year trial.

The trial will be developed using a balance between pragmatic and explanatory elements and will be adapted during the trial period.

Perspectives. This study will contribute to the development of methods and strategies for tackling complex health issues both according to the meeting with the individual patient as well as the development of the health care system. The study is in the initial phase developing the new care plan in a co-design process integrating different research approaches. This study raises several reflections concerning methodology and how to involve different knowledge areas, patients, their family and caregivers in the development of new care models.

Complex Adaptive Systems Approaches to Potentially Avoidable Hospitalizations. Implementing the Patient Journey Record System (PaJR) in Ireland and Australia

Carmel Martin

General Medicine Program
Monash Health, Melbourne, Australia
carmelmarymartin@gmail.com

Context and aims. The Patient Journey Record System (PaJR) implements a complex adaptive (CAS) person-centered approach to potentially avoidable hospitalizations (PAH). Telecare guides (TCG) regularly converse with at risk individuals to track concerns and health. PaJR initially piloted in a rural Irish cohort with 1 PAH in past year is being trialed in MonashWatch (MW) - an Australian deprived inner-city cohort with 3 PAH/year predicted using hospital analytics.

Aims. To compare profiles of MW (high risk hospital recruited) and Irish (lower risk primary care) cohorts.

Method. Telecare guides record conversation details in PaJR database which generates alerts for risk of deterioration, using algorithms validated in Ireland. Calls from the MW (n=616) and Irish (n=616) pilots were analysed. Variables include concerns, self-rated health, worrying disease symptoms transformed into alerts >24hour response, and high risk patterns requiring medical attention in 1-24 hours (red alerts).

Findings. Self-rated health (SRH) was similar in both cohorts (excellent to very poor categories). Concerns were raised in 238 (38%) MW calls and Irish calls 308 (50%); while 73% vs 83% calls reported no disease symptoms. Red alerts were generated in 28% of MW and 25% Irish calls. Pain, psychosocial distress and environmental problems clustered in MW (mean2.7 per call; median1) versus Irish (mean 0.45 per call, median 0). Irish alerts related more to breathlessness as the most frequent symptom.

Innovative contribution. SRH and alerts that require medical care demonstrated similar rates in MW and Irish cohorts. Pain, mental health, social and environmental concerns were clustered in the MW group, while the Irish had more physical disease and isolation. The MW group had a broader range of social and environmental problems of a non-urgent nature than the Irish group. The PaJR system using CAS is adaptable for use in 2 different cohorts and countries by addressing needs through person-centered conversations.

Is perceived Need-for-Action among Women in Violent Relationships Nonlinear and, if so, why?

Katerndahl, D; Burge, SK; Ferrer, RL; Becho, J; Wood, R

University Of Texas Health Science Center-San Antonio
San Antonio, TX, USA
katerndahl@uthscsa.edu

Background. We understand little of women's action-taking about their violent relationships other than it is qualitatively nonlinear. Nonlinearity could be due to: 1) nonlinearity of underlying violence, 2) presence of multiple, interdependent predictors or 3) circularly-causal predictors, or 4) an underlying cusp-catastrophic phenomenon (CCM) where the relationship between violence burden and readiness-for-action is distorted by factors affecting the relationship.

Aims & Objectives. To determine degree of nonlinearity in need-for-action (seeking help, taking legal action and leaving) among women in violent relationships, and identify source(s) of nonlinearity. Methodology. 143 women in violent relationships from 6 primary care clinics completed baseline and end-of-study surveys assessing hope, coping strategies, social network, and readiness-for-action concerning violence as well as daily assessments of household environment, marital relationship, concerns, and need-for-action collected via telephone Interactive Voice Response for 8 weeks. Measures of nonlinearity of violence, need-for-help, legal action or leaving were computed. To identify sources of nonlinearity, 1) multiple regression assessed the relationship between nonlinearities of violence and need-for-action, 2) prior-day associations between daily variables and need-for-action using vector autoregressions were sought, and 3) impact of violence burden and bifurcation variables (hope & coping, support, forgiveness and number of children) on readiness-for-action were modelled using regression analysis, comparing the variance accounted for by CCM versus linear models.

Results. Degree of nonlinearity of need-for-legal-action was lower, but patterns were nonlinear for all needs. The source of nonlinearity of need-for-help could be any of the explanations except the underlying violence nonlinearity. The best explanation for nonlinearity of need-for-legal-action is that it is a catastrophic phenomenon. Finally, nonlinearity of need-to-leave could be due to readiness-to-leave as a catastrophic phenomenon or nonlinearity of need-to-leave linked to underlying violence nonlinearity.

Conclusions. Need-for-action is quantitatively nonlinear with different explanations for that nonlinearity, but all imply that intervention will not yield predictable results.

Mini-TED Talks 5
MODERATOR: David Aron

Saturday, October 28, 2017

Sturmberg	Linking the environmental and physiological components of health and disease
Doty, Kinsey and Bates	Analyzing Complex Medical Image Information: Convolution versus Wavelets in a Neural Net
Moore, Hertzberg and Chen	Assessment Framework on the Complexity in Primary Care Practice
Sarriot	Call an agent-based modeler stat! Bringing evidence to global health blind spots
Watkins	Organisational Relativity – Changing our perspective on health and healthcare

Linking the environmental and physiological components of health and disease

Joachim Sturmberg

University of Newcastle
Newcastle, Australia
jp.sturmberg@gmail.com

Health and disease are the result of highly integrated network interactions spanning the large scale of the external environment to the small scale of physiological pathways. In integrated networks, a change in one component has an effect on all other components regardless of that component's position in the network. The effects of the perturbation of network components may ultimately result in a person's experience of illness or lead to the phenotypic characteristics of a recognised disease.

As health care has the person and his health experience as its focus, how can we visualise the interactions between the external and the physiological components of a person's health and disease. As previously shown the health vortex visualises the health system domains and their impacts on healthcare for the person. There is another vortex that visualise the small scale domains that regulate the person's physiology.

Putting the two vortices together results in an hourglass appearance. As with an hourglass, turning it from one side to other, highlights the interrelated effects on the between the environment and physiology on the person. This will be illustrated in relation to obesity as one of the most pressing issues affecting the health of people, communities and nations in developed and developing world.

Analyzing Complex Medical Image Information: Convolution versus Wavelets in a Neural Net

Elena A. Doty, C. Matthew Kinsey and Jason H.T. Bates

Department of Medicine
University of Vermont College of Medicine, Burlington, VT, USA
jason.h.bates@uvm.edu

Deep learning neural networks have shown great promise for the automated analysis of complex medical images. Here we focus on the problem of discriminating malignant from benign lung nodules seen by computed tomography (CT). This is a major public health issue because only about 1 in 20 suspicious lung nodules that are seen on CT, many requiring invasive exploration, are actually cancerous. We used the software platform Tensor Flow to construct a multi-layer perceptron neural network (MLP) in which three layers of hidden neurons with 48, 24 and 12 nodes, respectively, connected to two output neurons corresponding respectively to cancerous and benign. We also constructed two extended versions of the MLP by adding a preceding layer consisting of: 1) 64 3 x 3 parallel convolutional filters with learnable weights (CONV), and 2) 4 wavelet band-pass filters with pre-assigned weights (WAVE). MLP, CONV and WAVE were each trained on 450 CT images of cancerous lung nodules and 845 images of benign nodules, using batch sizes of 30-100 images run over 30-150 epochs. MLP, CONV and WAVE were tested on a separate set of 187 cancer and 114 benign images. All achieved very similar classification accuracies of 74.3 1.4 % (combined mean). The training times for MLP and WAVE were within a mean of 1.5 % of each other, but CONV took an average of 87 times longer to train as a result of its much greater number of free parameters. These findings suggest that the three networks extracted essentially the same amount of information pertaining to the presence or absence of malignancy, but that MLP and WAVE were much more efficient than CONV in this task. This illustrates the importance of matching the complexity of neural network design to the complexity of the objects being classified.

Assessment Framework on the Complexity in Primary Care Practice

Roseanne Moore, Marsha Hertzberg and Junqiao Chen

Evolent Health
Arlington, VA, USA
mhertzberg@evolenthealth.com

Background. As early as 1998, an empirical study revealed that primary care practices were complex adaptive systems and later viewpoints from Martin and Sturmberg highlighted that these complexities are poorly understood. As Evolent Health collaborates with primary care practices on their transformation to value-based patient-centered care, understanding these complexities is essential for implementing any changes.

Aim. To develop and operationalize a complexity-aware assessment framework for primary care practice optimization.

Methodology. We developed and gradually revised a comprehensive assessment tool that includes the functional domains from the Patient-Centered Medical Home model of care. The tool is tailored to the specific goals of a practice optimization initiative. During an in-person visit, this tool serves as a guide for trained Evolent staff to semi-structurally interview practice leadership. Practice staff in their various roles are also observed. While other available assessment tools generate simple itemized readiness scores, we focus more on the interconnectedness of factors internal and external to the practices.

Results. From 2014 to 2017, we assessed 35 practices in 7 US states. Each assessment generated unique results, however the assessment of a particular Ohio practice for an initiative targeting hypertension and diabetes care revealed many common characteristics of a complex adaptive system. These include obstacles in using Electronic Health Records for proactive care management due to functional limitations and lack of staff training, the difficulty in managing patients covered under various insurance plans, the evolving roles in a shared care team structure, and the unpredictable outcomes of patient outreach. Recommendations were shared with the practice during a follow-up visit and an action plan was developed to address these interconnected challenges.

Conclusion. Evolent's assessment revealed improvement opportunities in busy primary care practices facing complex clinical, technical, administrative and interpersonal challenges. Lessons learned will be useful for those in the process of value-based care transforming.

Call an agent-based modeler stat! Bringing evidence to global health blind spots

Eric Sarriot

Sr. Health Systems Advisor, Department of Global Health
Save the Children USA, Westport, CT, USA
esarriot@savechildren.org

Global health faces critical questions about the sustainability of its remarkable recent achievements. From a central planning perspective, fidelity to evidence-based practices dominates the framing of learning and evidence about 'what works'. Closer to implementation, some documented approaches suggest a neglected role for respecting self-organization principles in order to achieve effectiveness and sustainability. Examples are found in community systems, women's groups, within health care provider structures, and in relations between the two types of actors. There is however a substantial gap in building evidence between the two levels: the "what", which global planners can identify, and the "how" on which practitioners claim expertise, particularly about harnessing self-organization and the risk it carries with regard to implementation fidelity.

Josh Epstein's Agent_Zero provides an agent-based modeling (ABM) platform bringing together contextual, deliberative/cognitive, emotional, and social determinants of behavioral disposition, which could be assigned to a mother, a community member, and a community- or facility-based health worker, then tested against aggregate system level performance metrics (health care delivery or community systems). In addition to cognitive (e.g. standards, training, and supervision), and contextual factors (e.g. availability of drugs, infrastructure, financing), commonly considered in global health research, behavioral and organizational sciences help us identify a first set of emotional and social determinants for the disposition-to-act of mothers or workers.

Using lessons from social, management, and implementation science to Agent_Zero-type models could powerfully accelerate learning: testing 'what if' scenarios; ruling out large scale tests when modeling reveals likely unintended effects; bringing together disparate behavioral and organizational theories about agents' behaviors; and establishing more robust theories worth testing through implementation research.

ABM can also provide the theory-based visibility and reliance on evidence, which policy makers need to support innovations. Implementation researchers, practitioners, and modelers need to work together to accelerate this agenda.

Organisational Relativity – Changing our perspective on health and healthcare

John Watkins

Cardiff University/Public Health Wales
Cardiff, Wales, United Kingdom
john.watkins@wales.nhs.uk

Nearing the 150th anniversary of the publication of Darwin's theory of evolution, it is important to reflect that he expressed two sides to the process of evolutionary change, 'survival of the fittest' and a 'tangled bank'. In his 'tangled bank' he saw the interplay between organisms of different species 'dependent on each other in so complex a manner'. More recently, Kauffman reframed the 'survival' and 'variation' questions in terms of new doors opening for species by variation, rather than survival against the odds due to random evolutionary bias. This alternate view of the 'adjacent possible' recognises, as Darwin did, that within organisms there exists natural variation, this variation, opens up new possibilities for life to evolve. Much the same process by which the humble telephone has given rise to the internet, to the success of Amazon, Google and Twitter, all of which have occupied the 'adjacent possible opened up by mass communication and Smart phones. Kauffman contests that life exists in the complex domain between ordered and chaotic systems poised at the edge of chaos, where the capacity of a system to evolve is optimised. More recently Noble has introduced the concept of biological relativity in which, in deference to Einstein, contests that there is no privileged position of control in biology, that the genome is neither the 'blind watchmaker' or the conductor of the orchestra. In reality, Noble suggests, it is the complex interaction of the environment with the organism, its cells and intracellular environment, that brings out life in all its diversity and co-evolutionary development - Darwin's tangled bank.

This paper will explore the ideas above and, using the concept of fitness landscapes, try to suggest that in the organisation of health and healthcare we need to adopt an holistic approach and abandon a reductionist, simplistic, perspective.

Keynote Addresses
MODERATOR: Paige McDonald

Saturday, October 28, 2017

West	Fail Small, Fail Often
Seely	Variability-derived clinical decision support to improve care

KEYNOTE. Fail Small, Fail Often

Bruce West

Army Research Office,
Research Triangle Park, NC, USA
bruce.j.west.civ@mail.mil

Human beings distrust statistics, in large part, because they are not comfortable with uncertainty. They are suspicious of unpredictable variability and in Western Society, as beneficiaries of the manufacturing age, they rely on the controlled sameness of all things. This includes the top down approach for suppressing variability, contained in the management strategy of Six Sigma. On the other hand, the implications of artificially suppressing natural volatility, in order to achieve stability, can be remarkably harmful in the information age.

Pushing the natural variability from the central region of the bell-shaped probability density, out into the tails of the probability, has two effects: 1) the natural low-level variability disappears from the policymakers field of vision, making everything appear calm and trouble free; 2) when a suppressed fluctuation does appear it is completely unexpected and devastating. Strategies that artificially suppress all variability to achieve short-term stability of a complex environment, do just the opposite. Such deceptively calm environments eventually experience massive blowups, catching everyone off-guard and undoing years of stability, often ending up in a far worse situation than their initial volatile state. This is evident in the recurring ‘unexpected’ stock market collapses; the remarkably disruptive geopolitics of the Middle East; and even the more benign crises of the healthcare system.

An alternate strategy would be to take advantage of natural variability, by judiciously applying the innovator’s mantra “fail small, fail often”. In this way local failures are induced in complex processes by natural variability, as is always the case. Failures are kept small through timely human intervention and catastrophic failure is thereby avoided. Make the natural, social and physical unpredictable variability of this complex world your friend and they may just reveal some of nature’s secrets of control to you.

KEYNOTE. Variability-derived clinical decision support to improve care

Andrew Seely

Ottawa Research Institute
Ottawa, ON, Canada
ajeseely@gmail.com

Care for patients experiencing critical illness is enormously costly and impactful; and health information management research inspired by complex systems science is ripe for innovation that benefits patients. We hypothesize that advanced software tools designed to track an underlying system help identify system change earlier, including trajectory and response, and enable beneficial system change. Our aim is to introduce groundbreaking patient-centered health information management software tools that help inform clinicians of the system state of the patient, specifically when they are assessing the patient for a pending clinician decision. In the Intensive Care Unit, physicians make clinical decisions daily that critically impact both patient and hospital bottom line, yet often based on variable and subjective interpretations of data. Trying to improve decision-making, we developed software to monitor multiorgan variability (degree and character of patterns of variation over intervals-in-time) to provide a novel means of monitoring a patient's underlying systemic host response to critical illness. Using variability analysis and machine learning, we derived prediction models that optimally predict successful extubation (so patients can be liberated from mechanical ventilation and safely resume breathing on their own). We have completed a multicenter study to derive the model, initiated an observational study of the Extubation Advisor (EA) software prototype. We are ready to initiate a feasibility multi RCT to determine if it is technically feasible to deploy the EA tool, have it used by clinicians and determine if it even impacts on extubation decision making, in several centers. Our aim is to determine if a future RCT to determine if EA will reduce time to successful extubation is feasible and worthwhile. This innovative use of commonly monitored (usually discarded) health information research, by converting waveforms to variability to predictive models to clinical decision support, has potential to help transform monitoring and improve care.

Mini-TED Talks 6

MODERATOR: Gaetano R. Lotrecchiano

Saturday, October 28, 2017

Seely	Monitoring adverse events and using positive deviance to improve surgical care
Sturmberg	Deviant Behaviour is neither Irrational nor Ignorant
Chen and Patel	The Challenge in Quality Measurement: the Complex Interplay of Technical Difficulties, Social Construct, and Business Enterprise
Nortrup	Quality and Value in Healthcare: Simple Goals for a Complex System
Scott	The Healing Journey: Healing as an emergent property of complex social interactions

Monitoring adverse events and using positive deviance to improve surgical care

Andrew Seely

Ottawa Research Institute
Ottawa, ON,Canada
ajeseely@gmail.com

As an approach to try to improve quality of surgical care, we monitor all adverse events (AEs) occurring after all surgeries performed by a collective of thoracic surgeons who lead a team of professionals to care for a population of patients. We hypothesize that monitoring AEs and outcomes provides a measure of quality of care provided by the system of health care providers, and use of this data that optimizes emergent change in that system is possible. We combined surgeon self-assessment and anonymized peer-comparison with continuous quality improvement seminars utilizing positive deviance (CQI/PD) to identify surgeon(s) with the lowest rates of adverse events (AEs) was a catalyst, along with best evidence, to guide group practice change. Our objective was to quantify the impact these interventions on post-operative AEs rates after major non-cardiac chest operations. All postoperative AEs after all thoracic operations (n=1084, 03/2013-02/2016, single-centre) were prospectively collected using the Thoracic Morbidity & Mortality System, based on Clavien-Dindo schema. Online software provided surgeons (n=6) with self-evaluation and peer comparison at all times. Additionally, quarterly CQI/PD seminars (n=8,09/2013-12/2015) focused on common impactful AEs: atrial fibrillation (AFIB), prolonged alveolar air leak (PAAL), and anastomotic leak (AL). Impact was analysed using univariate statistics 6, 9, and 12-months before and after implementation. We observed reductions of post-operative AEs after CQI/PD: a decrease (all time periods) in AFIB, greatest at 6-months (10.1% vs. 6.7%; p=0.36); a decrease (all time periods) in PAAL, greatest at 12-months (18.9% vs.11.7%; p<0.05); and decrease (6 and 9- months) in AL, greatest at 6-months (11.1% vs. 8.3%; p=0.82). The longitudinal study design has inherent limitations, and results require multicenter evaluation. Improvements in AE rates following individual surgeon self-evaluation and CQI/PD seminars provide encouraging results that merit further investigation.

Deviant Behaviour is neither Irrational nor Ignorant

Joachim Sturmberg

University of Newcastle
Newcastle, Australia
jp.sturmberg@gmail.com

"*A 1998 landmark study reviewing the quality of care in the United States indicated that some 30% to 50% of care delivery was not in line with best available evidence.*" [1] Is this a problem or does it reflect adaptive implementation of "all that is known" in the context of this person under his particular circumstances?

The statement implies (1) that best available evidence is uncontestable, has universal validity and applicability, (2) that best available evidence equates to knowledge, and (3) that a person not conforming according to best available evidence is either irrational or ignorant.

On face value, these implications might hold true in a cause-and-effect world. However, many health professionals experience their world as complex, embedded in multiple different organisational and environmental networked contexts.

Evidence. The "scientific method" is generally regarded as the way to generate the evidence that verifies or refutes a hypothesis based on observations and experiments [2], with a single contradictory observation refuting a hypothesis [3]. In the natural world observations generally show patterns which is inconsistent with the assumptions underpinning the "scientific method".

Knowledge. Knowing is personal [4] and arises from learning. Learning involves linking observations (data) which creates information, and linking various pieces of information creates knowledge.

As Peter Drucker observed, data, information and knowledge only provide the building blocks for "doing things right", however, "doing the right thing" requires an additional step, namely the consideration of the consequences of implementing knowledge in context.

If evidence results from complex interactions in the natural world, and knowledge results from the complex personal appreciation of evidence, applying knowledge in one's complex context reflects wisdom. So-called "deviant behaviour" as described above indeed reflects rational deliberative behaviour, not irrationality or ignorance.

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The Challenge in Quality Measurement: the Complex Interplay of Technical Difficulties, Social Construct, and Business Enterprise

Junqiao Chen and Milesh Patel

(a) The George Washington University
Washington, DC, USA
qchen@evolenthealth.com mpatel@evolenthealth.com

This presentation focuses on the complex interplay of the technical, social and business factors in quality measurement, and will solicit suggestions from the audience to address complexity.

Quality measures (QMs) often show technical complexity by using many clinical concepts and heterogeneous coding schema, as well as complex logic beyond simple “if-then” rules. Socially, quality measurement is a complex area as elaborated in the Bulletin of World Health Organization that the driver of utilization is likely the “perceptions” of quality of care under the influence of social networks. To date, reporting on QMs has become a complex business enterprise. The U.S. National Quality Measure Clearinghouse contains 2588 measures developed by 126 organizations from private and public sectors. Companies are competing to contract with federal agencies to develop new measures. Organizations such as the National Quality Forum (NQF), a third-party measure endorser, will increasingly face challenges to reduce measure redundancy and promote harmonization between QMs. As more reimbursement models shift toward value, the use of QM results will be increasingly important. However, surveys of clinicians suggest high rates of burnout by QMs, with $15.4 billion spent annually just on reporting.

Questions will be asked to encourage attendees to brainstorm ideas that will tackle these complexities. Should measure developers quantify technical difficulty as well as the cost and return of measure implementation? How can the industry better support NQF in continuing to assure scientific acceptability, maintain harmonization and reduce the use low-value measures? Is there space to accommodate social norms and patient preference especially when they are contradicted to recommended care? Should we focus more resources on educating providers and patients on how to react on measure results so that we improve the timeliness and delivery care?

Quality and Value in Healthcare: Simple Goals for a Complex System

Kevin Nortrup

Principal, Sugar Creek Solutions
Fairland, IN, USA
sch@sugarcreeksolutions.com

There is nearly universal call for greater quality, value, resilience, efficiency, scalability, and sustainability in healthcare. However, there is far less agreement on how such improvement should be achieved or even what it would entail. Most discussions and proposed solutions reflexively target emergent pain-points and other symptoms but not the underlying root causes, with likely results being the recurrence or repositioning of problems instead of their remediation.

The difficulty in improving quality and value in healthcare can be traced to a “perfect storm” of two human tendencies: theorists tend to overcomplicate the simple; and practitioners tend to oversimplify the complex. Elaborate, esoteric edifices are constructed around the concepts of quality and value, and these edifices are inhabited by insular experts whose very presence can diminish others’ means, motives and opportunities to advance quality and value. Furthermore, although everyone admits that healthcare is a complex, sociotechnical system of systems, most attempts to improve it encounter protected traditions, entrenched assumptions, siloed optimization and countless other failures to understand, to analyze and to remediate it systemically – or to apply the mindsets and methodologies from other systemic disciplines to it – with predictable, inescapable yet unintended consequences.

This presentation suggests a return to simple concepts of quality and value that can encourage, equip and empower everyone in healthcare to internalize quality and value as essential elements of their responsibilities. It examines how healthcare today overlooks fundamental principles of systems and proposes how we might analyze, design, implement, operate and remediate healthcare as a system “if we didn’t know any better,” balancing naïveté and skepticism with humor to propose alternatives to traditional assumptions and entrenched practices. Finally, it explores how a transition of focus from “getting better” to “staying well” is every bit as applicable, effective and essential for healthcare itself as it is for patients.

The Healing Journey: Healing as an emergent property of complex social interactions

John Scott
Northeastern Vermont Regional Hospital
StJohnsbury, VT, USA
john.glenn.scott@gmail.com

Purpose. To elucidate pathways to healing for people having suffered injury to the integrity of their function as a human being.

Methods. A team of physician-analysts conducted thematic analyses of in-depth interviews of 23 patients who experienced healing, as identified by six primary care physicians purposefully selected as exemplary healers.

Results. People in the sample experienced healing journeys that spanned a spectrum from overcoming unspeakable trauma and then becoming healers themselves, to everyday heroes functioning well despite ongoing serious health challenges.

The degree and quality of suffering experienced by each individual is framed by initial conditions that include personal characteristics, timing of their initial or ongoing wounding in the developmental life cycle, and prior and current relationships.

Complexity theory informs a model for the healing journey for participants, where bridges from suffering are developed to healing resources/skills and connections to helpers outside themselves. These bridges often evolve in fits and starts, and involve persistence and developing a sense of safety and trust.

From the ongoing iteration between suffering and developing resources and connections, a new emergent state develops that involves hope, self-acceptance, and helping others. Over time this leads to healing, defined as a sense of integrity and flourishing in the pursuit of meaningful goals and purpose. Healing is therefore an emergent property of the complex healing journey.

Conclusion. Moving from being wounded, through suffering to healing, is possible. It is facilitated by developing safe, trusting relationships, and by positive reframing that moves through the weight of responsibility to the ability to respond.

Mini-TED Talks 7 - Health Systems Stream

MODERATOR: Peter Tsasis

Saturday, October 28, 2017

Price	Complexity Medicine Now. Transforming Medicine from the Biomedical Model to a Systems and Complexity Model
Costa	Strengthening health systems, how can this be done?
van der Kamp	Positive Cooperation for Sustainable Health
Kuziemsky, Gruniewicz and Ghazzawi	Systems Model of HIT Induced Complexity
Abbas	Systems Thinking to Improve Effectiveness, Efficiency, and Equity in Health
Botelho	Cultivate Open Mindsets for Equity and Planetary Health: How Can Leaders and Change Makers Close the Advocacy-Action Gap?

Complexity Medicine Now. Transforming Medicine from the Biomedical Model to a Systems and Complexity Model

Eddie Price

Complexity Science Medical Systems Pty Ltd
Sydney, Australia
eddieprice@ehealthier.net

BACKGROUND. The need for change: health systems in the OECD world are unsustainably expensive. By incorporating Systems Theory and Complexity Theory into medical practice, we can address this. Some complexity theorists contend that the human body is a Complex Adaptive System and as such, its health is dependent on dynamics previously regarded irrelevant or beyond scope in relation to having a bearing on an individual's health status. Analysing these dynamics may guide us to addressing the unsustainability issue profoundly.

AIM. The aim is to find a methodology of adding Systems/Complexity Theory into medical practice to complement the current biomedical model.

The question we must ask "Is there any way to use IT to achieve this now and are there other recent advances that have become available due to the IT revolution that could assist?"
Health outcomes have emerged as the central focus for establishing value-based health and patient-centred care. In the past health outcomes were considered too subjective and costly to warrant collecting, however IT and research advances (particularly in Complexity and Item Response Theory) now makes their case far more compelling, indeed irresistible.

ENTER PSYCHOMETRICS AND WHAT IS NOW KNOWN AS PROMs as a proxy for measuring and targeting the underlying interconnectivity, functionality, adaptability and feedback loops to achieve what we consider to be healthy (optimal health outcomes).

METHODOLOGY. PROMs (Patient Reported Outcome Measures) are the scores from patient-completed, validated questionnaires especially designed to quickly measure health functionality currently experienced by the patient. Complexity Theory is concerned with the dynamics of interdependencies and PROMs, measured over time, can tap into multiple system dependencies (behavioural, socio-economic, environmental etc) and record their dynamics individually. When analysed collectively they can unlock new interconnections, relationships and efficiencies between policy decisions and health outcomes.

PROMs measure the impact of multi-level systems at the individual level and above, that is the person's lifestyle, behaviours, nutrition, family connections and community connections, and therefore are measuring the Suprasystem of the individual patient.

PROMs questionnaires always have an object, that is they measure the effect of the illness on the patient's ability to participate in a particular way in their work or play. This is measuring the interconnections between the patient and their environment. All Complexity Science is based on interconnectivity and dynamics which in the health area, are easily measured by PROMs.

RESULTS. The introduction of an app with a suite of PROMs initiated by physicians and completed by patients could be the first step to incorporate Systems/Complexity Science into medical practice. Aggregated data would provide a wealth of insight to population health dynamics and identify best practice and technique improvements across all jurisdictions that adopt PROMs monitoring.

Strengthening health systems, how can this be done?

Joao Costa

Swiss Tropical and Public Health Institute
Tirana, Albania
joao.costa@swisstph.org

It has become consensual that most problems affecting health sectors are systemic and must be addressed with systems thinking approaches. Several concepts and frameworks have been proposed. This paper is a theoretical reflection based on the System Theory developed by Niklas Luhmann; a theory that has attracted attention among some analysts of health systems, but remains mostly unknown.

Central to Luhmann's theory for understanding the possibility of strengthening health system are the concept of autopoiese and the notion that systems distinguish themselves from their environment. Autopoiese implies operational closure, by which the system mobilizes internal components and selforganizes its operations for continuation, reproducing its elements and its distinction from the environment. For that, the system needs the capacity to observe both itself and its environment. Furthermore, a system is made of communications.

In simple terms, strengthening a system requires making it aware of itself and its environment, in other words, more capable of observing, and communicating what is observed. However, without distinctions, observations are not possible; therefore, systems draw distinctions. Distinctions separate elements of the environment in the categories of relevant (in line with deployed distinctions) and irrelevant (those remaining in the unmarked area, outside system's concerns). By deploying distinctions, the system becomes capable of addressing the complexity of the environment, reducing it. Paradoxically, however, in this process the system becomes itself more complex.

In conclusion, strengthening a health system implies fulfilling its autopoiese drive, and use its resources for its operations (observations and communications). The diversion of system's resources away from its operations makes it weaker. This plan of analysis implies that key observations and communications have to be performed by those who are instrumental for the reproduction of the system. This has important implications for donors supporting developing countries.

Positive Cooperation for Sustainable Health

Jan van der Kamp

Health Systems Innovations, University of Amsterdam
Blaricum, The Netherlands
kampjan@ziggo.nl

In many areas of society the question arises how a transition can be reached towards sustainability, with resources that can be made use of, without using them up. Also in healthcare it's worthwhile to make this question actual. The present medical system mainly delivers services that are used up, consumed. The question is, how intrinsic health building and healing capacities can be helpful in the health care system. The intrinsic emerging power of life and wellbeing is promising a huge potential.

A positive appreciation of human behaviour deserves more attention. Basically humans are competent to rule their lives, including their health. Through their essential involvement they are natural partners in health. It is good to realise that people are no longer only consumers of health care services, but are seen more and more as co-producers. Self-determent people develop their commitment and skills to become as independent as possible. Not at least this is facilitated by the information- and social media. Empowering the competence is a positive goal for better Health.

In cybernetic terms, the vector of the influencing force acts as positive feedback, and evokes a transition that will find in living systems a new dynamic equilibrium. With a negative feedback transitions can be reached with a constant need of the feedback force. In terms of sustainability, in the positive feedback is made use of, without using up, whereas in the negative feedback scenario it remains to use up energy. This is an important property enabling health services to act more effective and more efficient.

Mixing up the given information were health care providers and their customers behave as adaptive agents, it will be of interest how they interact and what can emerge from it in the scope of "Health as the ability to adapt and to self manage" [1]

The Health Care System **Cure** and **Care** can cooperate with man how to **Deal** and with their biological and mental dynamics to **Heal**. The interactions of Cure, Care, Deal and Heal are forming a trans disciplinary approach for Health.

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Systems Model of HIT Induced Complexity

Craig Kuziemsky, Agnes Gruniewicz and Andrea Ghazzawi

Telfer School of Management
University of Ottawa, Ottawa, ON, Canada
kuziemsky@telfer.uottawa.ca

Background. While health information technology (HIT) is playing a key role in transforming the healthcare system into a collaborative patient centered system, it is common for unintended consequences (UICs) to emerge post HIT implementation. Healthcare delivery is a complex adaptive system and UICs occur because of a complex array of interactions between technology, users, organizational policies and other situational contexts. Understanding the nature of these interactions and the manner in which they occur is a necessary first step to managing UICs from HIT implementation.

Aim. To understand how health system complexity contributes to HIT facilitated UICs in order to develop a systems model of HIT induced complexity.

Methodology. We use a case study of a perioperative system to develop an upstream-downstream model of HIT induced complexity. We draw upon existing research on UICs in healthcare and contextual implementation factors to guide our analysis and identification of complexity categories in our model.

Results. Our model identifies complexity interactions with data entry & retrieval, workflow and communication and coordination. Some of these interactions are flexible, others are fixed, and others are temporal and display emerging properties over time. Some interactions start upstream but evolve in complexity downstream through the accumulation of multiple issues. Understanding the nature of these issues enables us to proactively manage them, for example by providing additional training or having discussions of trade-offs that need to occur across different users.

Conclusion. Implementing HIT in complex settings such as healthcare organizations is a significant challenge. While the complexity of healthcare delivery prevents us from predicating the specific interactions that lead to UICs, our model enables us to make inferences about the likelihood of some interactions and the contextual circumstances where they occur. By better understanding the complexity of HIT implementation we can proactively manage the occurrence of UICs.

Systems Thinking to Improve Effectiveness, Efficiency, and Equity in Health

Kaja Abbas

Department of Population Health Sciences
Virginia Tech, Blackburg, VA, USA
kaja.abbas@gmail.com

Health policies and programs are designed with the triple goals of improving effectiveness, efficiency, and equity in population health. But these three goals of improving effectiveness, efficiency, and equity are systematically aligned in a balancing feedback loop. Thereby, with existent technologies, improvements in all three areas are commonly impossible, while novel technologies can be innovative in improving all three goals compared to the status quo. The systems theoretical framework will be presented to illustrate the balancing feedback mechanism between effectiveness, efficiency, and equity. The comparative metrics will be discussed for effectiveness, efficiency, and equity of different health programs that can facilitate in decision making for prioritization and allocation of limited public health resources among different programs. Opportunities for novel technologies will be highlighted to innovate in improving effectiveness, efficiency, and equity of health policies and programs, with a case study of a novel technology (currently under investigation) of community administration of ivermectin to humans and livestock animals to reduce malaria transmission.

Cultivate Open Mindsets for Equity and Planetary Health: How Can Leaders and Change Makers Close the Advocacy-Action Gap?

Rick Botelho

Retired Professor of Family Medicine
University of Rochester, Rochester, NY, USA
rbotelho@me.com

Introduction. The Declaration of Alma Ata (1978) advocated for attaining the highest levels of possible health for all, along with the health, social and economic sectors. This Declaration failed to fulfill its promise because it underestimated the ethical and political complexities of transforming health and healthcare systems. The advocacy glass is half empty. How can we close the advocacy-action gap to create an overflowing glass of shared abundance?

Personal and planetary health are intimately intertwined complex adaptive systems, without any simple or reductionist solutions. The demise of planetary health will make the challenge of striving towards equity more difficult, especially for poor and vulnerable populations. This calls on the global health and planetary health movements to work collaboratively on reducing inequities and restoring planetary health.

Equity and planetary health are interdependent civic virtues for achieving the Sustainable Development Goals. These values call for putting the common good above self-interests and aligning self-interests to serve the common good. Our greatest barriers to change are our closed mindedness and our inability to shift from the “I” to the “We” mindset.

Objectives. Questions for generating dialogue
How can we:
* Use public narrative to share stories about what’s unfair in health/healthcare?
* Inspire ethical and political integrity?
* Open closed mindsets?
* Develop simple rules to manage complexity?

Methods. Small groups will use separate handouts to: 1) discuss the meaning and implications of the one question (see above) and 2) evoke strategic thinking about closing the advocacy-action gap.

Outcomes. Participants are invited to join an ongoing learning collaborative for those interested in:
- Becoming facilitators for the course: Cultivate Open Mindsets for Equity and Planetary Health
- Develop calls-to-action for educational, clinical, research, innovation, advocacy, policy and political purposes.

Watch podcast about course: https://goo.gl/LTAFxa

Mini-TED Talks 8 - Education & Improvement Stream

MODERATOR: Chad Swanson

Saturday, October 28, 2017

Lotrecchiano and Misra	Features of Transdisciplinary Knowledge Producing Teams (TD KPTS): A Systems Perspective
Miller and Hanson	A Relational Coordination Theory Informed Nurse Residency Program
Swanson and Widmer	Arizona State University: An Example of a Complex Systems Approach to University Transformation
Hausmann and Nelson	Capitalizing on Complexity: The Stories Behind the Numbers in a Global Health Initiative
McDonald, Harwood and Weaver	Scoping Reviews: A Mechanism for Conveying the Value of a Complexity Approach to Problem Exploration and Knowledge Generation
Konitzer and Fink	Paradigm Shift or Diffusion? Complex Diagnostic Taxonomies and their Implementation. A Comparative Epistemological Study

Features of Transdisciplinary Knowledge Producing Teams (TD KPTS): A Systems Perspective

GR Lotrecchiano and S Misra

George Washington University
Auburn, VA, USA
glotrecc@GWU.edu

Aim/Purpose. This paper proposes to bridge transdisciplinary team characteristics with the study of communication in teams. It proposes the question “”what does the systematic study of transdisciplinary teams tell us about communication?” This paper addresses (1) a typology of transdisciplinary teams for observation and analysis; (2) features of communication within transdisciplinary teams; and (3) the role of complexity science in bridging the study of transdisciplinary teams with communication studies.

Background. Working within transdisciplinary teams is a challenge as researchers and scholars strive to solve complex problems amidst rapid change and the complexities of coping with competing and shifting priorities. Inquiry into these sorts of complex teams requires a commitment to gathering and analyzing data that are dynamical representing emergent change within teams.

Methodology. The paper draws on literature on transdisciplinary teams as well as highlights trends that can inform research and techniques for observing transdisciplinary teams.

Contribution. By reviewing the definitions and impact these features have on the task of researching communication processes in transdisciplinary teams, scholars can inform the major challenges that transdisciplinary teams face on a regular basis: integration, praxis, and engagement.

A Relational Coordination Theory Informed Nurse Residency Program

Cheryl Miller and Kelsey A. Hanson

Billings Clinic
Billings, MT, USA
cmiller11@billingsclinic.org

When implementing a nurse residency program, Billings Clinic looked to Relational Coordination (RC) to help develop and deliver impactful curriculum over the first two years of a new graduate RNs professional practice. Several key pieces of the curriculum assist the new graduate RN to build valuable connections, identify key resources, and better understand the complexity of healthcare systems today. The program goal is to assist in preparing the next generation of health professionals to understand and use complexity science and relational coordination. The nursing residency program has also provided fresh insights into how learning happens and can be fostered in health systems, particularly in a hospital system with multiple discipline residency programs.

Billings Clinic's Nurse Residency Program is unique in that it calls on and works collaboratively with both the Internal Medicine Residency and the Pharmacy Residency in many of their sessions. The nurse residents also meet valuable resources from Respiratory Therapy, Physical Therapy, Occupational Therapy, Speech Therapy, Dietary, Laboratory, Supportive/Palliative Care, Bioengineering, Wound Care, Psychology, and Research departments in our scheduled monthly sessions.

The residents from the different residency programs are afforded an opportunity to learn together, feedback to each other, and better appreciate each other's roles, responsibilities, and frustrations working within the same healthcare system together by the end of the sessions. Learner feedback has shown the program improves interprofessional communication, skills in giving and receiving feedback, improved shared goals, and mutual respect with the understanding of each other's perspectives. Shared knowledge begins to happen naturally, as an outcome of the teams working together. Many times although not planned, impromptu RC in action happens right in front of us as the team members are working and communicating at a different understanding of their shared goals in patient scenarios in the simulation lab.

Arizona State University: An Example of a Complex Systems Approach to University Transformation

Chad Swanson (a) and Matthew Widmer (b)

(a) Arizona State University College of Health Solutions, Tempe, AZ, USA
(b) Brigham Young University, Provo, UT, USA
swancitos@gmail.com

Since the Flexner Report, our collective thought in health and education has been dominated by a biomedical reductionist paradigm. All of what we do—the questions we ask, the tools we use to identify causal relationships between exposure and disease, the interventions we employ to improve health, and the structure of our health and educational institutions—is largely guided by biomedical reductionism. The health challenges we face, such as obesity, rising healthcare costs, and antibiotic resistance are not amenable exclusively to reductionist approaches. We need a global paradigm shift toward complex systems thinking in health and education in order to create a world that is more healthy and equitable.

Over the past decade, Arizona State University (ASU) has experienced a historical transformation under the direction of Michael Crow, and is a global leader in redefining higher education. ASU, described by Crow as a “complex adaptive knowledge enterprise” [1], serves as an example of how a shift toward complex systems thinking can fundamentally alter the institutions which determine health outcomes.

ASU began transforming when key leaders started challenging entrenched mental models [2], like “what makes a university prestigious?”, “how do students learn?”, “why do we organize departments and disciplines the way we do?”, and “who should have access to higher education?”. They rallied behind ideals [3] of inclusiveness, interdisciplinary collaboration, and social embeddedness and impact. As a result, the institution fundamentally changed [4]. Academic departments no longer resemble the typical American university, with distinct professions and rigid boundaries between departments. Multidisciplinary collaboration centers emerged, and a partnership with the Mayo Clinic blossomed [5]. Enrollment increased with a more robust online-education platform [6]. In our presentation, we will consider the ASU story as an example of the application of complex systems concepts to university education, and its implications.

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Capitalizing on Complexity: The Stories Behind the Numbers in a Global Health Initiative

Robert Hausmann (a) and Jennifer Nelson (b)

(a) University of Houston, Founding Director, Health Sciences Leadership Academy, Houston, TX, USA
(b) Technical Officer, Salud Mesoamerica Initiative, Inter-American Development Bank, Washington, DC, USA
rchausmann@uh.edu jennifern@iadb.org

Background. This research uses narrative-as-data to tell the stories behind outcome measures in a global health initiative. The approach used in this research recognizes that impact takes place in a dynamic, complex adaptive system, which has consequences for monitoring and evaluation, policy dialogue, and decision-making.

Methodology. We spent six months on a data-gathering mission collecting over 2200 stories in eight countries of the Salud Meso-america Initiative (SMI). This research used a wisdom of the crowd approach, in this case the crowd of local implementers in a regional health initiative. The purpose was to understand what implementers are doing through stories of success and failure, why attitudes change over time, and how to enable system change. To understand these insights, we used a narrative data collection and analysis tool, that includes cognitive sciences, complex adaptive systems, and anthropology. Participants interpreted their own stories into a series of constructs, which allowed meaning to emerge and provide quantitative data, which was linked back to the original stories.

Results. We generated visual data from their stories and interpretations at the country and regional-levels of analysis. This resulted in finding patterns in those experiences, allowing decision-makers to 'make sense' of the stories in the database. Insights were then evaluated by decision makers to improve planning for health innovation programs.

Conclusion. In a complex adaptive system, insights can be gained by analyzing patterns in stories to support decision making in a global health in three areas:
1. Extending the value of existing monitoring systems and provided guidance on porject design informed by experiences from the field.
2. Identifying lessons from implementing a global health initiative by reducing the "distance" between policy-makers and practitioners.
3. Rapid sensemaking of narratives coupled with facilitation techniques creates a safe space for a reflective environment, which helped health officials improve interventions

Scoping Reviews: A Mechanism for Conveying the Value of a Complexity Approach to Problem Exploration and Knowledge Generation

Paige L. McDonald, Kenneth J. Harwood and Jennifer Weaver

The George Washington University
Washington, DC. USA
paigem@gwu.edu

Background. The George Washington University School of Medicine and Health Sciences (GWU SMHS) launched a new PhD in Translational Health Sciences (THS) in August 2016. The PhD in THS is an interdiscipline aimed at yielding translational research through collaborative ecologies that will achieve greater social impact. Therefore, very early in the curricula, it is essential that we introduce courses and content which will help students move beyond their disciplinary silos to adopt new ways of knowing and exploring complex health problems and to develop an appreciation for the value of adopting a complexity lens for problem exploration prior to move toward problem solution.

Aim & Objectives. In this presentation, we detail our rationale for adopting the “Scoping Review” within our course on “Translational Health Science in Complex Health Systems” as a mechanism for promoting student comprehension of the complexity of a given health problem and for developing their appreciation of the value of complexity as a lens for problem exploration. In particular, this assignment helped students map the interdependencies among stakeholders related to a complex health condition, identify which stakeholders were currently researching and writing about the condition and which were not, and determining tensions among stakeholders that might serve as barriers to future knowledge generation.

Results & Conclusions. We will share examples of the scoping reviews completed in the course. We will discuss how the final assignment submission indicate appreciation of the value of diverse stakeholder perspectives in negotiating potential barriers to future knowledge generation.

Paradigm Shift or Diffusion? Complex Diagnostic Taxonomies and their Implementation. A Comparative Epistemological Study

Martin Konitzer(a) **and Waltraud Fink**(b)

(a) **Academic Teaching Practice, Department of Family Medicine MHH, Schwarmstedt, Germany**
(b) **Family Physician, Straning, Austria**
m-konitzer@t-online.de

Background. During the second half of the 20th century Austrian Family Physician R.N. Braun, German Pathologist K. Lennert and German Psychiatrist K. Schneider developed new diagnostic classifications for their disciplines. Braun's was named "Law of Case Distribution", Lennert's "Kiel Lymphoma - Classification" and Schneider's "Clinical Psychopathology". The fates of these complex diagnostic approaches give rise to questions concerning mode of implementation – paradigm shift or diffusion - and its promoting and inhibiting factors.

Methods/Material. The textual corpus consists of Braun's, Lennert's and Schneider's textbooks and biographical reports. This corpus is processed by content – analytical qualitative (Strauss 1994) and bibliometric quantitative approaches (Moretti 2005). The former describes the corpus' content, the latter tracks its history of implementation into the scientific community.

Results. Blending empirio-critical categories of German idealism (Kant) with their disciplines' taxonomies Braun, Lennert and Schneider shaped diagnostic matrices to handle the complex challenges of family medicine's epidemiology, lymphoma's pathology and psychodiagnostics. The dynamics of international acceptance of these complex taxonomies follow a diffusional mode (Rogers 1962) rather than one of paradigm shift (Kuhn 1962). As Lennert's and Schneider's taxonomies were implicitly adopted by WHO and DSM Braun's taxonomy was adopted only as a preliminary stage of ICPC (Internat. Classific. of Primary Care).

Discussion. These different rates of innovations' adoption between Lennert and Schneider on the one hand and Braun on the other are discussed and classified in terms of diffusion – theory of innovations (Rogers 2003). Promoting and inhibiting factors of these different adoptions are discussed under transcultural aspects (Mead 1964, Murray 2003), aspects of thought style (Fleck 1935), group dynamics (Schachter 1961) and complexity thinking's history (Sturmberg et al. 2014) and future we self – referentially are a part of.

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